SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

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WEEKLY.

A LARGE GAS ENGINE.

It has generally been supposed that gas engines were necessarily limited to 30 horse power and under, and that where larger engines are required they must necessarily be made by compounding smaller ones. Our engraving, however, shows a large gas engine made by H. W. Caldwell & Son Company, Chicago, Ill., and used in the large grain elevator of Taylor Brothers, at Cooper's Point, Camden, N. J.

This engine is rated at 100 horse power. It is operated by carbureted air, consisting of a mixture of common air and gasoline vapor. This provides a fuel which is not only invariable in quality, but is quite inexpensive. In large quantities the gasoline costs six cents per gallon in large cities, and as this engine is operated by one gallon of 74° gravity gasoline per horse in ten hours, it will be seen that the cost of fuel is very light compared with the power yielded. As the engine is working at present it is developing 62 horse power actual. The cylinder has a bore of 16½ inches and the stroke is 24 inches. The crank shaft has a speed of 150 revolutions per minute. The gasoline is drawn directly from a tank considerably lower than the engine, and its vapor is mingled with the air without any special carbureting device. The governor limits the number of charges admitted to the cylinder by controlling an air gate over one of a pair of air tubes shown at the rear of the engine. The air gate has two ports and allows air to be drawn through either tube according to the action of the governor.

In one tube there is a nozzle leading upward from a reservoir containing less than a pint of gasoline, and when the port above this tube is opened, the engine takes in an explosive charge. The charges are ignited by an incandescent tube incased in a larger tube lined with asbestos.

Heretofore, one objection to large gas engines has been the use of tube timers. In this engine they are entirely dispensed with. Another objection to large gas engines has been the difficulty in starting. In some cases, small auxiliary engines have been used for this purpose. All this is obviated in this engine by the use of a novel self-starter, which consists of a hand pump used for forcing the charge into the cylinder and a detonator for exploding the charge after it has been introduced. This device gives the engine its first impulse, after which it continues to operate steadily with its automatic gear.

As this engine requires no fireman or skilled engineer, and as it uses cheap fuel which leaves no residue, it is apparent that this engine has great advantages over the steam engine. The credit of the invention of this engine is due to Mr. James A. Charter, who has long been known in the gas engine business.

Agricultural Experiments in Maine.

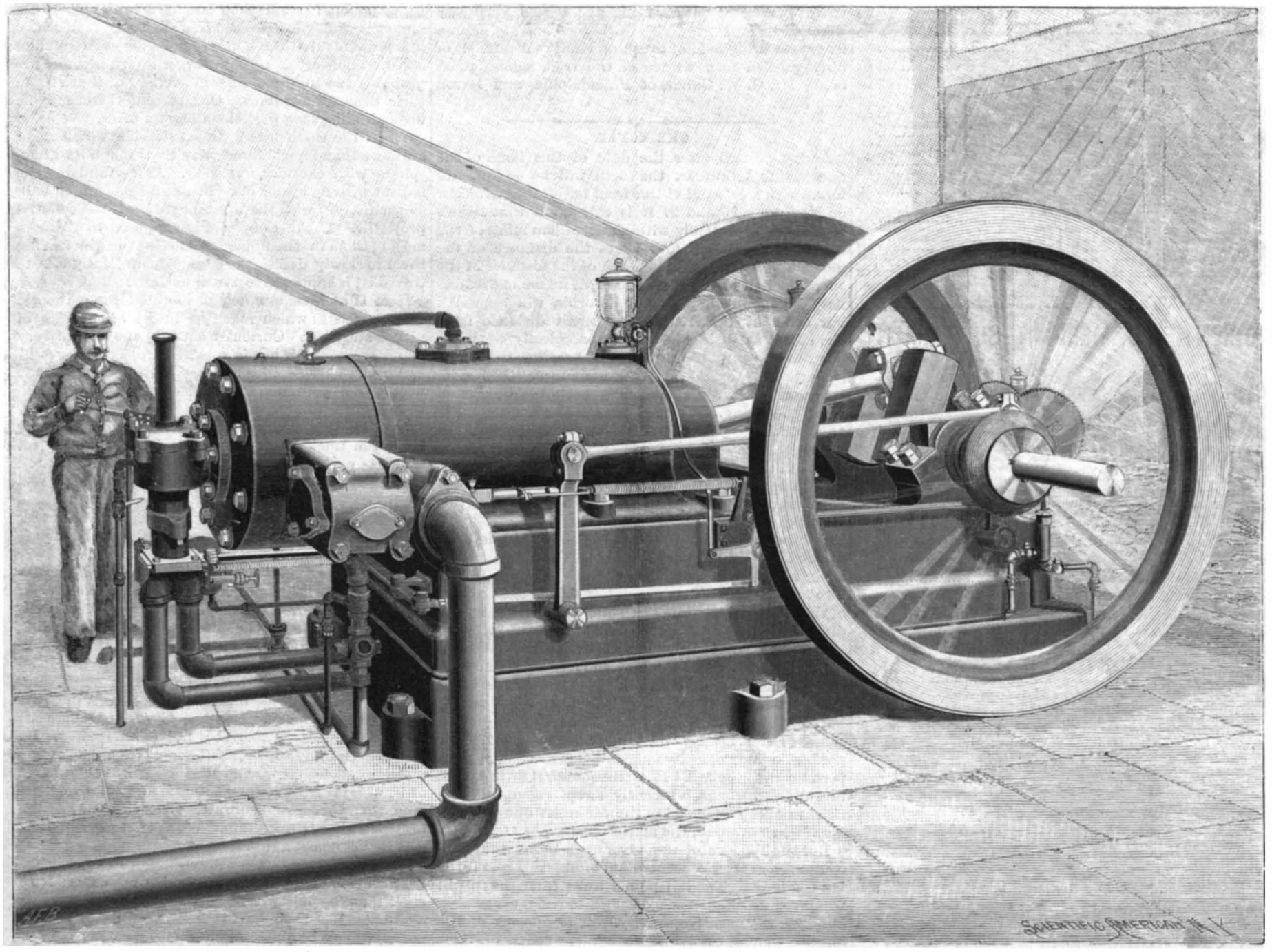
The officers of the Maine State College Agricultural Station deserve commendation for the manner in which they have carried on their researches with a small appropriation. In their report for 1891 some interesting experiments are described, especially those on the digestibility of various foods, such as Hungarian grass, beets, turnips, bran, meal, etc. The animals were confined in separate pens for seven days before the excreta bags were attached and records commenced. Care was taken to prevent waste of the food, which was weighed.

Another series of experiments were made on the effect of different forms and mixtures of fertilizers. Thirty-six one-twentieth acre plots were laid off and numbered. With oats, dissolved bone-black produced, on the average, the largest crop.

The Most Useful Mineral.

If one were to ask his friends what mineral we are most familiar with, and most commonly used for food, the answer would probably be most varied and amusing. Salt would, I fancy, first suggest itself to many, and to those whose training in physiology and hygiene has not been neglected, no doubt the claims of lime and iron and carbon, which, in one form or another, we use with food to build up bones and brawn, would be amply urged. But, after all, it is water, for water is a mineral—a fused mineral. You will find it described as such, along with quartz and topaz and the diamond, in Dana's "Mineralogy," or in other treatises on stones.

We usually think of minerals as solid things, such as metals and rocks and jewels and various chemical salts. But when we consider the matter a little, we see that all these things, if melted by strong heat, are minerals still; only they are now in a fluid instead of a solid state. The difference between these minerals and water is that water gets fluid at a lower temperature that they do, and, like quicksilver, stays melted at ordinary living heat. But in those old ice ages, which, one after another, have swept now over the northern hemisphere, bringing ruin and desolation, the natural and common condition of water was that of a solid—ice—as it largely is to-day out of doors in winter, when not kept fused by the stored-up heat of the soil and rocks, or melted by the sun.—*Mineralogists' Monthly.*



ONE HUNDRED HORSE POWER GASOLINE ENGINE.

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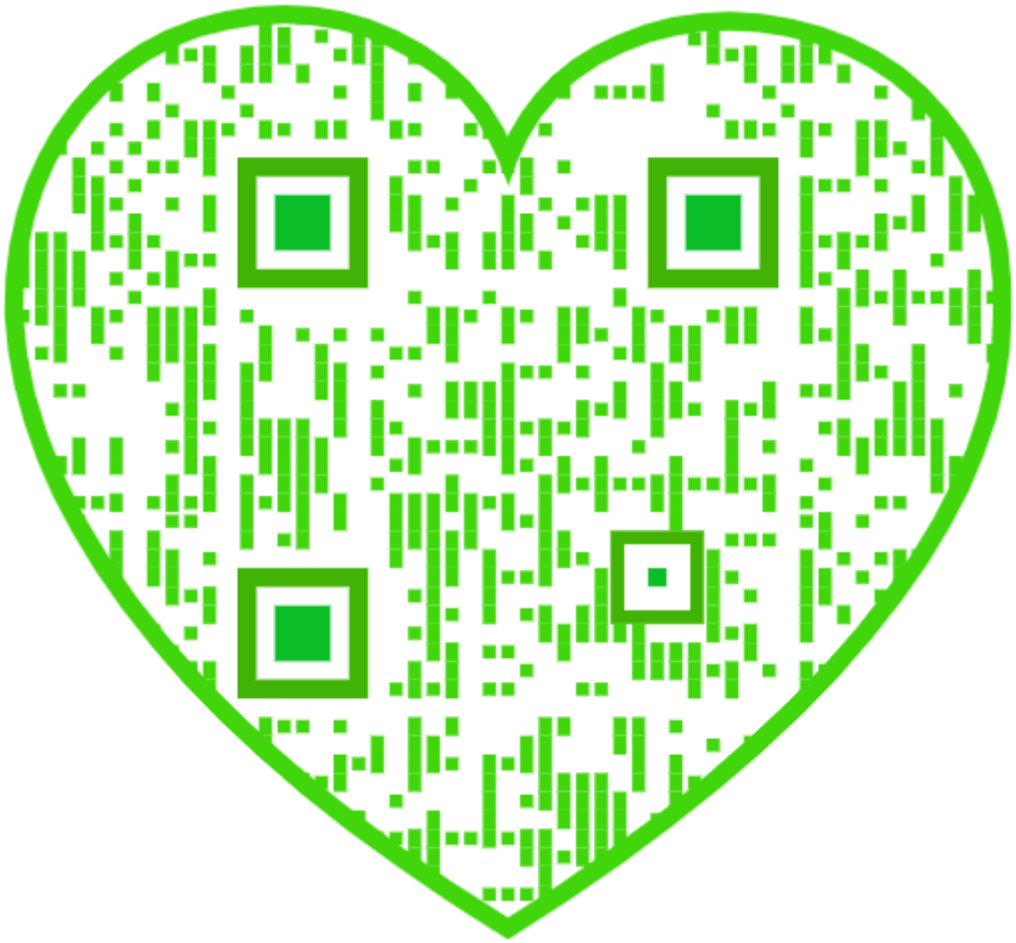

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A RECENT PROJECTILE TRIAL.

A very interesting ballistic trial of an armor-piercing projectile took place on November 10, at Reddington, Pa.

While great strides have been made in the development and manufacture of armor and guns in this country of late, the subject of armor-piercing projectiles has not been neglected. The projectiles that have stood the most severe tests and are considered the most excellent in the world are those known as the Firminy and the Holtzer, the balance of favor being with the latter. They are both made in France.

In this country a number of steel makers have taken up the study, manufacture, and development of projectiles, some having purchased the secret processes of foreign makers.

The projectile fired at Reddington was one that had been manufactured under the Wheeler process, by the Sterling Steel Works, at Demmler, Pa. This projectile had been tested by the government officials at Indian Head Proving Grounds, Maryland. There it was fired from a six inch breech-loading rifle at a six inch nickel-steel armor plate. It penetrated the plate and wood backing of thirty-six inches and embedded itself in the earth bank behind the target. After recovery, it was found to be in perfect condition. It had been so little injured and distorted that it could be and was pushed through the bore of the gun from which it was fired. It had been upset or shortened a very small fraction of an inch, and the diameter had been so slightly increased that there was no danger of its sticking or jamming in the bore of the gun.

It was then sent to Reddington, to Lieut. J. F. Meigs, United States navy, who fired it again on November 10. He gave it a velocity of 1,660 feet per second, firing at a soft nickel-steel plate of 14 inches thickness. It penetrated the plate to a depth of 9¼ inches and raised a front bulge of 2½ inches in height and 16 inches in diameter. The shot hole was surrounded by a large combing wave fringe. The projectile rebounded to the rear a distance of 125 yards, and two large pieces of it were found. About one-twentieth of the projectile was lost, and no doubt that part was broken up into small fragments.

The point and ogival head were in splendid condition and were highly polished. The cylindrical part of the projectile had split longitudinally, one part remaining intact with the ogival head, the other part detached.

The average projectile either breaks up or becomes so distorted on the first fire at a modern armor plate that it is useless; but this one had passed, with very slight distortion, completely through one plate, and on its second firing did not break up badly. A number of distinguished men witnessed the trial, among them being Mr. G. W. Childs, of Philadelphia, and Baron Von Leer.

THE COMET.

A day or two after the date of this issue of the SCIENTIFIC AMERICAN the earth will be on intimate terms with a celestial visitor from far-off regions. For on November 26 and 27 it is calculated that Biela's comet will be probably within one million miles of the earth. This is about four times the distance of the moon, and about one hundredth of the distance of the sun. The hair star or tress bearer, as its name "comet" may be rendered, pursuing its orbit, will approach our orbit at this remarkably small distance from the earth, as distances are astronomically considered. The chemist has analyzed meteorites, the petrographer has examined their structure; their constitution, and even shape, have been the objects of much theorizing. We now may make the acquaintance of what is possibly a producer of meteorites. In meeting Biela's comet we may observe phenomena that will elucidate some of the perplexities of meteorites. The equal perplexities that hedge what we know of the nature of comets may also be diminished by this meeting.

For to-day we know little of comets. They have as distinctive features a head or nucleus and a tail. The latter is of such excessive tenuity that although it may be conspicuous on the absolutely black background of the heavens, yet stars can shine with virtually undiminished luster through a million miles of it.

Sir Isaac Newton compared the brightness of a comet's tail to that of the motes in a sunbeam an inch or two thick. Imagine this diffused through the vast space filled by the comet. Sir John Herschel was so impressed by this tenuity that he put the weight of a comet's tail as being perhaps only an affair of a few pounds, or only of a few ounces. Our earth will meet perhaps with the tail. It is satisfactory to feel that in walking through a recently swept room the particles of dust suspended in the air resist our progress far more than would the matter in a comet's tail.

But the nucleus of the visitant is more solid and contains a greater concentration of mass. From it the tail emanates. The tail points away from the sun in whatever direction the comet is moving, suggesting Stockton's "negative gravity." The nucleus of the largest comets resolves into a mere speck of light when seen by the most powerful telescopes. But this speck may be solid incandescent matter or may shine by reflected light. From it in its passage through space fragments of all sizes may be torn off and distributed along the comet's orbit. The earth intersecting this orbit may pick up or attract into her atmosphere some of these fragments, and a fall of shooting stars, a meteoric display and a rain of meteorites to enrich some collector's cabinet may be the result.

The tail of a comet points away from the sun. Running down its axis, a dark straight line has been observed. This seems to be the shadow of the unknown nucleus. The knowledge we possess as to the size of the nucleus is negative and conjectural. In observed comets it may have exceeded one hundred miles. Therefore, in a cometary collision we may be struck by a white hot missile of these dimensions.

Volcanic eruptions making or annihilating islands impress us as overwhelming in their might. The impact of a cometary nucleus in the formation of a crater, with the possible penetration of the earth's crust, and in the creation of tidal waves, might affect the destinies of a continent.

But even this is all conjecture. Meteorites are principally composed of metallic iron and nickel. These incidentally are about the last things we should look for in them. The fact is that their composition is such. The theory that they are derived from comets is rather a favorite one with astronomers. To determine the constitution of comets the spectroscope has been applied and reveals the element carbon. This rather disconcerts the upholders of the cometary origin of meteorites.

An extraordinary thing is noted by Langley. Sir Isaac Newton, he says, made one of his "guesses" in this connection that take the nature almost of prophecy. Two hundred years before the spectroscope was invented, and a century before the work of Black had borne its fruits, Newton surmised that comets might supply the atmosphere with its carbonic acid gas. Our atmosphere in a few days may receive a new supply of this slight diluent or impurity.

The comet of 1680 was subjected to heat two thousand times greater than that of red hot iron, according to Newton's calculations. From the neighborhood of the sun the comet flew into the regions of almost absolute zero. These great alternations of temperature, it is probable, disintegrate the nucleus, and to that extent make it a possible source of meteorites.

The size of meteorites is generally small. In view of their high velocity this is a fortunate circumstance for us, who have to stand their bombardment. They are also very widely dispersed. In a shower of meteorites, it is probable that the individual masses are ten miles apart. Some of them are no larger than a pea, and are probably two hundred miles in average distance from their nearest neighbors. Our present visitor may be disseminating such particles along its orbit.

When the earth meets these asteroids, which are of far more than icy coldness, they fly through its atmosphere with enormous velocity. As certainly as the impact with an armor plate heats an iron cannon ball, so the friction with the atmosphere heats the celestial projectile. The mere friction is supposed to dissipate most of them in the upper regions of the air, leaving them to slowly descend as cosmic dust. Many tons of this dust is supposed to reach us daily.

Here is at least a notch or foothold for a theory. The meteorites which reach us intact are masses of nickel and iron. Curiously enough, one of the very alloys proposed for use in making projectiles for guns and armor for war ships is a nickel-steel alloy, so that we are not yet much in advance of the celestial artillery.

Leaving this aside, we may assume that, however large the nucleus of a comet is, it is composed for the most part of carbon and of easily disintegrated materials to which our atmosphere will offer a real resistance. Then we may suppose an exceedingly small part of it to be of sufficiently solid material to resist the gaseous friction of the atmosphere, and such part only we may assume can reach our earth.

This would account for the cosmic dust, and for the survival of the fittest projectile material, nickel-iron or nickel-steel, for even the carbon is there for its cementation. This gives us the satisfaction at least of feeling that our earth's envelope of oxygen and nitrogen will protect us from all but metallic projectiles, and if we are to be bombarded, it will be with improved and modern shot. For of all meteoric material, only the nickel-steel or nickel-iron alloy, as a rule, reaches the earth in masses. The rest is pulverized to dust. Its constitution may be widely different from that of the metallic meteorites we find on the earth. All or most of what is taught about comets and meteorites is little more than theory and surmise. Even the name of the present visitor is uncertain. We are not yet sure that it is Biela's comet at all.

THE demand for Percheron horses for export is so great that the purity of the breed is threatened, and a stud-book has been started in France by which the pedigree may be preserved and the race kept up to the standard

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The Typewriter in Cipher Writing.

A curious suggestion in regard to certain possible uses of the typewriter is made by M. Erve, in *Le Genie Civil*. It is well known that a favorite form of cipher writing consists in substituting certain letters for others, each party to the correspondence having the key by which he can place the substituted ones by those intended to be read. M. Erve points out that a secret correspondence of this sort can be carried on very readily by means of any typewriter. All that is necessary is to transpose types on the type-bars, so that, for example, touching the key marked A will print C, B will print R, and so on. After one instrument has been so transposed, the other is to be correspondingly rearranged, so that the key C will print A, the key R will print B, and so on. Then X., the correspondent at one end of the line, on receiving a cipher dispatch from the other, Y., has only to copy it on his typewriter. The machine, retransposing the letters automatically, will at once give an acurate translation, while X.'s reply, written on the same typewriter which translated Y.'s original dispatch, will form an unintelligible string of letters, which, by copying on Y.'s typewriter, will be in its turn translated. A cipher correspondence of this kind has an advantage over the ordinary sort, in that the two parties use different, although reciprocal, ciphers, and a comparison of dispatches captured from each will give little clew to the meaning of either. Moreover, it would not be very difficult, with some typewriters, which have two space keys, to make the space keys actuate types, so that the document would be an uninterrupted string of letters. Such writing is very difficult to decipher, from the impossibility of telling where the words begin or end; yet the corresponding instrument, by mere copying, would translate it perfectly.

Another use of the typewriter which M. Erve suggests is an instrument for shorthand writing. Most stenographers, in addition to the characters for sound, employ a large number of abbreviations and signs, usually of their own devising, which no one but themselves can understand. Hence it comes that stenographers cannot read any one else's writing but their own, and occasionally fail to read that when their use of abbreviations has been too liberal. M. Erve says, very truly, that characters indicating sounds with sufficient accuracy can readily be found in the typewriter alphabet, while a code of abbreviations might easily be agreed upon among stenographers. With such a phonetic system of using the characters, and a reasonable number of abbreviations, it would be easy to write four hundred words a minute on a typewriter, which would be fast enough for the most rapid speaker, while the stenographic writing would have the great advantage of being legible to any other stenographer besides the one who wrote it.—*American Architect.*

Has Albumen Received its Death Blow?

It will be remembered that recently, and as an append to a letter from the Britannia Works Co., relative to the uniformity of the tones obtainable on the Ilford Printing-out Paper (the "P. O. P." as it is usually termed), we spoke in terms indorsing their statement of this quality. This we did after a careful examination of from four to five dozen cabinet portraits which bore the name of W. H. Midwinter & Co., Bristol.

There was something so exquisitely beautiful and delicate and vigorous withal about these pictures that we felt impelled to address a request to Mr. Midwinter for detailed information concerning his *modus operandi* for publication either in the *Journal* or *Almanac* or both, as we saw occasion. To this a courteous response was made, with an offer, should we find it convenient to visit his establishment, to afford us every facility for witnessing the whole of his operations from beginning to end—an offer of which we promptly availed ourselves.

From the high position Mr. Midwinter occupies in the profession and his long experience in photography we consider him, more than many others, entitled to speak with authority—a feeling that has been strengthened since we spent a forenoon in his admirably fitted up ateliers in 48 Park Street, Bristol.

Conversing on the subject generally of our visit, we were informed that for a considerable time albumen had been entirely banished from his place, his printing now being confined to gelatine "P.O.P." and platinum. Information of this nature coming from such a representative man augured ill, we thought, for the long-continued tenure of the sway that albumen has had without any rival worthy of the name for these forty years past. Good old albumen! It has served us well during its reign; and, in the prospect of its being sooner or later deposed, we must endeavor to overlook demerits inseparable from its nature, and cherish its memory as that of an old friend who has rendered us good service. It is perhaps premature to cry, "The king is dead! Long live the king!" but, remembering our forecast many years ago concerning the chances of collodion retreating in favor of gelatine as a factor in making negatives, we imagine that, in course of time, and that too at a not distant period, albumen as an agent in printing will have to retire from the prominent position it has so long occupied.

Like so many other establishments, the printing room of Mr. Midwinter is covered in with glass, and it has the usual facilities for changing and filling the printing frames. It was, however, the subsequent treatment of the prints in which we were now more peculiarly interested.

Examining a few dozen prints as taken from the frames, we found that, contrary to the custom of some who use gelatino-chloride paper, these were slightly over-printed, not very much so, but to rather a less extent than adopted by experienced albumen printers. In the toning room, which is large and roomy, the utmost cleanliness and method prevail. Along one wall, that in which the windows are, there are arranged six slate tanks side by side. Above each there are water taps, and in the bottom are two outlets, one to permit of relegating valuable waste to its suitable receptacle, the other communicating with the sewers. We observed that no sooner had a tank been done with than it was thoroughly washed, sides and bottom, with a large sponge; and we further observed that separate sets of sponges and brushes are employed for the various tanks; thus, the brush for the hypo tank could not possibly be used in any but its own, unless one were willfully to ignore the lettering on its back. This cleanliness and method are perhaps due to the fact of Mr. Midwinter having in early life graduated in a chemist's establishment, where, above all places, cleanliness and method must reign supreme.

The first operation was to immerse the prints one by one in a water bath, from which, after a good soaking, they were transferred to the alum bath. This consists of—

Alum	4 ounces.
Water	80 ounces.

The chief printer—a most intelligent man—told us that he had at first adhered to the directions issued with the paper, which recommended *eight* ounces of alum to this quantity of water, but that he had reduced the strength to four ounces without any discoverable disadvantage. After remaining in the alum solution for ten minutes, the prints were then subjected to a wash in a succession of three changes of water. This washing was not done in a perfunctory, but in a thorough manner. At this stage the prints had lost the purple tone they had when taken from the printing frame, and had acquired a red color similar to that which albumen prints have at the stage after being immersed in a solution of chloride of sodium or acetic acid previous to being toned—a custom adopted by some.

The toning bath consists of—

Sulphocyanide of ammonium	30 grains.
Water	16 ounces.
Chloride of gold	2 grains.

Of this a quantity sufficient is poured into the toning dish to give the prints plenty of room in which to float about without danger of one sticking to the other. Mr. Midwinter strongly urged this as an important point both in convenience of working and as insuring uniformity of tone. We noticed that in measuring out the toning solution two-thirds of the bath used the day previous were taken and refreshed with one-third of a new bath. This we think is an excellent system, viewed either economically or from the point of convenience, for in our estimation some of the toning baths employed with gelatino-chloride paper act too energetically to enable the requisite care to be taken in seeing that, when a considerable number of prints are being manipulated by one person, due care is taken in insuring uniformity. How otherwise could it be when contrasted with the helter-skelter turning over of prints, accompanied by a fear to devote more than a very few seconds to the examination of any one print in case the others are in the meantime getting spoilt by over-toning? No occasion for such hurry when the toning solution is prepared as described. The printer here had time both to keep the prints in motion and to carefully and critically examine each one, which he did by transmitted light, holding it up against a gas flame before him. The average time for a print to acquire a purple black tone is about from eight to ten minutes. During these various operations the prints were kept almost invariably face down in the various solutions.

The fixing bath consists of three ounces of hypo-sulphite of soda to the pint of water. The best quality of soda procurable, although costing somewhat more than that of average quality, is alone employed, as it is found cheapest in the long run, and Mr. Midwinter has been taught by experience that ten minutes in a solution of the above strength is sufficient to insure the prints being thoroughly fixed. They are then washed for two hours in running water.

Let us pause for a moment to speak of the influence exerted by a bad sample of hypo upon the future of a print. Only a short time ago there was a perfect epidemic of spots on albumenized prints. Complaints respecting this reached us almost daily and from sources widely apart. No matter what care was taken or what brand of albumenized paper was employed, the plague prevailed. An observant professional friend in the North found that the prevalence of the spots in his case was concurrent with his using a certain kind of hypo which he had recently purchased. Acting on a surmise, he made two fixing baths, one with an old and the other with the new purchase. A brief period sufficed to establish the fact that the spots were attributable exclusively to the soda most recently procured. *How* it acted he could not tell; but that, in his case at any rate, it was the cause of the spotted prints he felt well assured. The subsequent employment of another sample insured freedom from all farther annoyance. We have written this *apropos* of Mr. Midwinter's care in using anything but the best quality of hypo.

With regard to the toning bath, forty-eight grains of gold for toning forty-two sheets of paper, and toning them well, cannot be considered otherwise than as being strictly economical. This, we were informed, is the proportion indicated by experience. There was no mealiness or defects of like nature apparent in any of the work done under the conditions described; indeed, we were told that such is altogether unknown.

The mounting is performed in the manner in common practice by many, that is, the prints are taken from the water and piled, face down, one on the top of the other. The surplus water is removed by gentle pressure on the top, but not to such an extent as to cause adhesion between them; starch is applied to the top one, which is then attached to the mount, and so on to the end. After spotting, they are placed in a grooved box, to remain for burnishing, which is done the next morning. The grooved box has a perforated zinc bottom and a drawer below in which two or more wet sponges are contained, the object being to prevent the prints becoming quite desiccated, which is inimical to their ultimately taking on the highest finish.

The burnisher, which acts the part rather of a hot roller than a burnisher pure and simple, is one of that form known as the quadruplex enameler, made by a Chicago firm. Having been passed through this a few times, the prints acquire a high glaze and finish; and, to prevent any curling, they are laid, face down, on a wooden table until cold; when taken up, they are quite flat. No lubricant is employed.

In the foregoing remarks we have given, in as brief a manner as possible, an account of the way in which we saw many gems of pictorial art produced. It is, however, proper that we should say that the negatives are pictorially and technically of great excellence. The former is doubtless owing to the fact that Mr. Midwinter, previous to becoming a photographer, had, on his return from the Crimean war, through which he had passed, gone in for an art education and graduated as a painter; the latter is a consequence of care, method, and a knowledge of what a photograph should be.

Before leaving, we had a look over the studio and adjoining rooms. The studio has a "lean-to" roof, fitted with double, nay, with quadruple spring roller blinds, one pair of white and blue overlapping each other, and either of them capable of being raised or let down. There is also a side vertical light, looking on a garden, the wall of which, with its trailing plants and bowlders, seems well adapted for the posing of large groups against.

Mr. Harvey, the operator, a near relative of the proprietor, who has been since youth with the firm, seems to have the art of lighting and posing the sitter at his fingers' ends; for, in an incredibly short period, he manipulated the screens so as to produce any effect desired. The reception and adjoining rooms are decorated with the choicest examples of Mr. Midwinter's work, and form quite an exhibition in itself.

The prices at this establishment are: 1*l.* a dozen for cabinets; 30*s.* for boudoirs; 2*l.* 2*s.* for imperials; and 3*l.* 12*s.* for panels.

In connection with the finishing of gelatino-chloride prints, we have been shown some examples of a method adopted by Mr. W. Crooke, of Edinburgh, which imparts to the surface a delicate matt that for many purposes has a charming effect. We have not been apprised of the method employed in producing this matt, although the paper is of the same brand as that used by Mr. Midwinter. From some experiments of our own, however, since made, by interposing a film of matt celluloid between the burnisher and the photograph, which imparts the effect in question, we may suppose Mr. Crooke's method must bear some resemblance to this.—*British Journal of Photography.*

THE *Iron Industry Gazette* complains that inventors are not, in these days, doing much that is important in the line of ironworking machines. Do they, asks the editor, consider these machines too nearly perfect to offer a profitable margin for work? Any practical ironworker can give the inventor an idea of improvements that are possible. The inventors ought not to turn from so important a field as this. It is not yet closed by any means.

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SARGENT'S SMOKE PREVENTING FURNACE.

The great desirability of some simple form of apparatus by means of which the smoke of boiler furnaces will be effectively consumed has long been conceded, and it is especially needed in all manufacturing centers where soft coal is used. It does not require many establishments, whose furnaces are fired with bituminous coal in the ordinary way, to pollute the atmosphere and deface the buildings of a pretty extensive area, with the large amount of smoke discharged from the chimneys, added to which is the waste of fuel accompanying this discharge, of which every engineer is conscious as he notices the volumes of black carbon rolling skyward. To obviate this difficulty is the design of the smoke-preventing apparatus shown as applied to a furnace in operation, in the accompanying illustration, and which has been patented by James Sargent, Esq., of Rochester, N. Y.

The apparatus works automatically, being controlled by a time movement. A pipe leads from the top of the boiler to the inside of the fire box at its front end, where, upon opening a valve, dry steam is discharged in powerful jets upon and over the surface of the coals, forcing the smoke, at the instant of forming, into the live coals, where it is consumed. The valve for starting the steam discharge is operated automatically with the opening of the furnace door to feed the fire, the swinging open of the door also actuating a lever connected with a time movement, whereby an air door is raised, the discharge of steam continuing, and the air door remaining open until the combustion of the newly supplied coal has been well started; and, finally, when the hydrocarbons are all distilled off and consumed, the steam jet and air door are both shut automatically. The time movement is adjustable, so that this period can be made longer or shorter, as may be desired.

That the combustion is actually improved by this smoke consumption is proved by the fact that the steam gauge shows increased pressure during the time the air door is kept open and while the fresh coal is being started, according to this method. The boiler tubes, also, do not require the frequent cleaning necessary under the old plan, being entirely free from the usual accumulation of gummy soot, but having, instead, only a slight deposit of a dry, ashy substance.

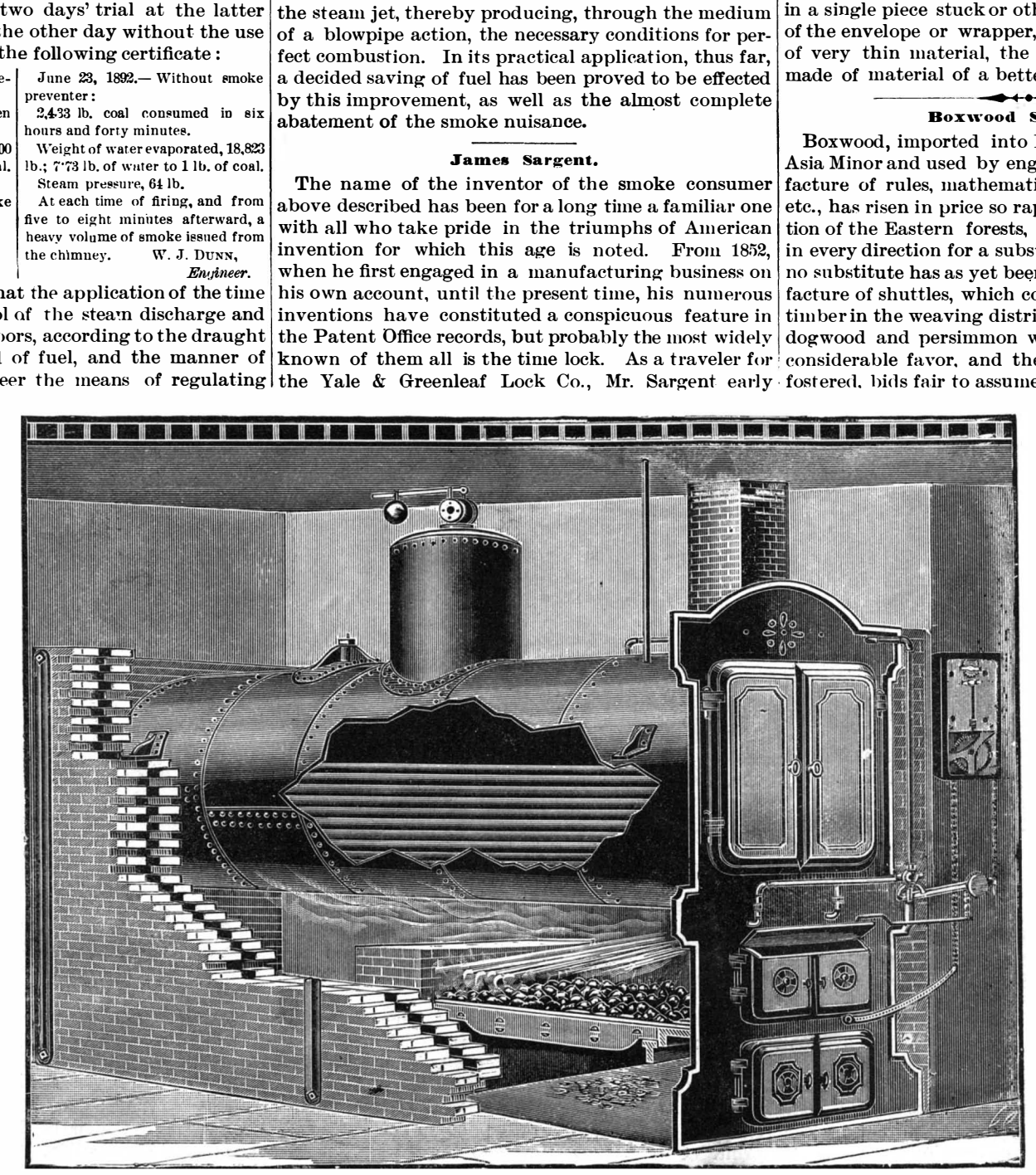
This smoke consumer has been for some time in successful operation in several large establishments in Rochester, N. Y., notably in the Kimball tobacco factory, and the result of two days' trial at the latter place, one day with and the other day without the use of the device, is given in the following certificate:

June 22, 1892.—With smoke preventer:
2,433 lb. coal consumed in seven hours and twenty minutes.
Weight of water evaporated, 21,600 lb.; 8·88 lb. of water to 1 lb. of coal.
Steam pressure, 66 lb.
Comparatively very little smoke at any time.

June 23, 1892.—Without smoke preventer:
2,433 lb. coal consumed in six hours and forty minutes.
Weight of water evaporated, 18,823 lb.; 7·73 lb. of water to 1 lb. of coal.
Steam pressure, 64 lb.
At each time of firing, and from five to eight minutes afterward, a heavy volume of smoke issued from the chimney. W. J. DUNN,
Engineer.

It will be readily seen that the application of the time movement, for the control of the steam discharge and the operation of the air doors, according to the draught of the furnace, the kind of fuel, and the manner of feeding, gives the engineer the means of regulating the working of the apparatus in such manner as to almost entirely prevent the escape of smoke into the air, practically irrespective of the condition of the weather. The apparatus may be attached in a few hours to any steam setting, without in any way interfering with its regular and continuous use. It is durable, and when once in place, requires no more attention than any other fitting to the boiler or furnace. It is moderate in first cost, and its use in the majority of cases will lead to an economy of fuel more than sufficient to pay for it in a short time.

As shown in the sectional elevation of steam boiler and furnace with the apparatus attached and in full operation, the dry steam is conveyed from the top of the boiler and injected into the fire box through two properly arranged jets with a special form of tip, two jets being thought, in ordinary cases, to give the best results, although in one class of special cases a single jet will be sufficient, while in another, three or more will be used. The special tip is so constructed as to distribute a thin sheet of steam moving with high velocity throughout the entire upper portion of the fire box. As shown in the cut, the steam jets enter the fire box above the air inlet, whence it results that the current of air is carried into the furnace in a solid column, which for a considerable portion of its journey from the boiler front to the bridge wall is mostly confined between the sheet of steam above it and the live fire beneath. The specific heat of air is so slight that the entering air current quickly reaches the temperature of the incandescent coal beneath, so that by the time the current reaches the vicinity of the bridge wall it is in proper condition to produce, in conjunction with the steam, a complete combustion in the manner described. Moreover, during the latter part of the journey from front to rear in the fire box, the expansion of the air current has caused it to ascend and mingle with the steam jet, thereby producing, through the medium of a blowpipe action, the necessary conditions for perfect combustion. In its practical application, thus far, a decided saving of fuel has been proved to be effected by this improvement, as well as the almost complete abatement of the smoke nuisance.



SARGENT'S SMOKE PREVENTING FURNACE.

James Sargent.

The name of the inventor of the smoke consumer above described has been for a long time a familiar one with all who take pride in the triumphs of American invention for which this age is noted. From 1852, when he first engaged in a manufacturing business on his own account, until the present time, his numerous inventions have constituted a conspicuous feature in the Patent Office records, but probably the most widely known of them all is the time lock. As a traveler for the Yale & Greenleaf Lock Co., Mr. Sargent early became a noted "lock pick," and, finally, in 1865, commenced the manufacture of a lock invented and patented by himself. As a prominent feature in this invention, a powerful magnet was introduced, which held other parts sufficiently under its control to prevent the use of a micrometer in measuring motion or determining relative positions of the unlocking devices. This was, and is, known as the Sargent magnetic bank lock. A mechanical, automatic device was later introduced for the same purpose, which dispensed with the magnet, and is the prevailing style at this time, under the name of the Sargent automatic bank lock. Numerous experiments, improvements, and changes were constantly made, until, in 1873, Mr. Sargent perfected his first model of a time lock, which was put in practical use by a bank at Morrison, Ill., in May, 1874, and is still in service. This style of lock has proved a wonderful success, and it is said that the original forms were so complete and comprehensive that no radical change has been found necessary in the lock up to the present time. Mr. Sargent, though still retaining his interest in the lock business, is also engaged in a diversity of other enterprises.

AN IMPROVED ENVELOPE AND WRAPPER.

A letter envelope, or a wrapper for holding newspapers or other packages, made after the method shown in the illustration, may be easily opened without any possible injury to the contents, the envelope or wrapper being also cheaply made. The improvement has been patented by Mr. Timothy J. O'Donnell, of Lawrence, Mass. The envelope or wrapper has its fastening flap provided with re-enforcing or extension flaps adapted to be doubled over the fastening flap along its two edges. The extension flaps are gummed on tne surfaces which come next the body of the envelope or wrapper, and at the central point of the flap, where the two extension flaps meet, the flap is bent outward, a small portion at that place being left ungummed, thus affording a free or unfastened end piece, by taking hold of which the envelope or wrapper can be easily torn open. This saves tearing off the ends of the envelope and preserves its contents entire. The re-enforcement of the wrapper afforded by this re-enforcing flap is designed to be especially valuable with wrappers the body of which is made of cheap, thin material, easily tearing or breaking at the point gummed. If desired, the extension flap may be made in a single piece stuck or otherwise secured to the flap of the envelope or wrapper, and, where the latter are of very thin material, the re-enforcing strip may be made of material of a better quality.

O'DONNELL'S ENVELOPE AND WRAPPER.

Boxwood Substitutes.

Boxwood, imported into England from Turkey and Asia Minor and used by engravers, and for the manufacture of rules, mathematical instruments, shuttles, etc., has risen in price so rapidly, owing to the exhaustion of the Eastern forests, that dealers are searching in every direction for a substitute. For engravers' use no substitute has as yet been found, but for the manufacture of shuttles, which consumes vast quantities of timber in the weaving districts of England, American dogwood and persimmon wood are beginning to find considerable favor, and the trade in these woods, if fostered, bids fair to assume considerable proportions. The American consul at Manchester, Mr. Grinnell, writes as follows concerning it: The best wood from the United States to supersede boxwood is dogwood (cornel, as it is more commonly called here), which, owing to its relatively moderate price ($18 to $20 per ton), may, it is thought, if more carefully selected, ultimately replace the more expensive boxwood for the purposes in question. The pieces should not be less than five to six inches in diameter, in length as long as convenient, say twelve feet, to be cut here into thirteen or fourteen inch lengths for working up. Of course, the wood should not be split, and the greater the diameter the better, if the heart is sound and it is free from other fault. It is again urged upon the shipper, as vital to the interests of himself and the trade, to reject all doubtful or bad pieces.

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ELECTRO-MECHANICAL TELEPHONE EXCHANGE.

This, as its name indicates, is a telephone exchange or switch capable of being manipulated from a distant station by means of electricity. Its object is to give each subscriber perfect control of his connecting device at the central office, thereby dispensing with the services of attendants; that is, the subscribers themselves do all that is to be done in calling up any other telephone.

Fig. 1.—TELEPHONE WITH KEYS ATTACHED.

The mechanism by which this is accomplished is illustrated by Figs. 1, 2, and 3. Fig. 1 represents all there is at the subscriber's office, consisting of the usual telephone apparatus and three or more keys, as required, marked from left to right as release, units, tens, hundreds, etc. Fig. 2 represents one of the switching machines at the central office, consisting of a switch disk having a hundred or more terminal contact points, with its accompanying machinery. Fig. 3 represents a complete central station, the machines and batteries being placed upon shelves along the sides of the room.

The machines at the central office are provided with mechanism by means of which the various connections are made.

On shelves at the central office are as many of these machines as there are telephones or subscribers. Each machine belongs, as it were, to its particular telephone, and is distinguished by the same number, No. 1 machine belonging to No. 1 telephone, and to that only; nor can No. 1 machine be manipulated from any other telephone. The wires connecting the keys with their respective magnets are termed manipulating wires, to distinguish them from the telephone wires.

The telephone wires, which enter the central office in one or more cables, are also numbered to correspond with the number of the wire terminals of the machine.

Calling up is effected as follows: Suppose that telephone No. 25 wants telephone No. 123. No. 25 presses his hundreds key once, tens key twice, units key three times. No. 25's connecting arm is then on the twenty-third contact point of the second row of wire terminals; that is, on the one hundred and twenty-third contact point.

To signal subscriber No. 123, or call him to his phone, No. 25 rings his bell, which operation also rings No. 123's bell. Conversation may then be carried on in the usual manner, after which the ear phones are hung up and No. 25 presses his release key, thereby actuating the release magnet, allowing the arm to return to normal position, by means of the weight seen at the left in Fig. 2.

In machines having over one hundred contact points, the contact arm has another motion by which it is enabled to reach any desired row. By using the thousands and tens key the contact arm jumps over ten rows, or ten points in a row, as the case may be.

A private wire device connected with this system insures perfect privacy of conversation, so that not even a person at the central office can hear what is said. At the same time, if either party is wanted, his bell may be rung, notifying him that he is wanted, which call he may answer or not, at pleasure.

Among the points of superiority of this system over the old may be mentioned: a great saving in cost of a telephone system, particularly in large towns; the expense of operators required in the ordinary exchanges, both day and night, is entirely avoided; the costly and troublesome switch board is also unnecessary; instantaneous connection; no cutting off conversation by operators at the central office; and disconnecting by the pressure of a single key.

It is claimed that instruments of ten thousand connections can be as readily and easily manipulated as one of one hundred.

The Strowger Automatic Telephone Exchange, of Chicago, was incorporated November 18, 1891, under the laws of the State of Illinois, M. A. Meyer being president, A. B. Strowger vice-president, J. Harris secretary.—*Electrical World.*

Salt Water Distribution in Cities.

The Olympic Salt Water Company has received its first installment of 25 per cent of the iron pipe which is to furnish sea water for San Francisco from the ocean, and it is now laid out along Post Street, from the new Olympic Club building to Van Ness Avenue. The pipe has been much delayed by a process of painting with paraffine, as the wax had to be imported from the East. The directors of the company expect to have the pipe laid very rapidly, now that a start has been made, and hope to be pouring the salt water into the city early next year. The scheme is to establish a large pumping station near the Cliff House and erect engines capable of hoisting 3,000,000 gallons of water every twenty-four hours to a large reservoir near Forty-third and Point Lobos Avenue, which is nearly 300 feet above the city base level. The pipes will be 12, 14, and 16 inches in diameter, made of cast iron and coated with asphaltum and paraffine. A system of mains and division pipes will be run all over the city, terminating at the foot of Third Street, where the water will discharge into the bay. If the water be not used, the whole 3,000,000 gallons must pass through the sewers to flush them every day. The water will be used for a large number of baths and tanks all over town, besides being put into private houses, used for sprinkling the streets, subduing fires, and furnishing small motors with power. There will be about six miles of pipe necessary to bring the water in. The new Olympic Club will be the first establishment furnished with the salt water.

The plan originated with the Olympic Club members, who made estimates and procured the franchise.—*Pacific Lumberman.*

Bags instead of Barrels for Sugar.

The Philadelphia *Record* states that "the Sugar Trust has contracted with John T. Bailey for 5,000,000 bags to take the place of barrels for the shipment of refined sugars. The bags will be delivered in New York, New Orleans, and Boston, as well as in Philadelphia. This is by far the greatest bag contract ever made in the United States. Philadelphia is the center of this important industry. The trust's reason for the change from barrel to bag is that the bag costs and weighs considerably less than its old-time competitor. The weight of the bag is only 1½ pounds, that of the barrel 23 pounds. Thus the difference in freight alone for carrying refined sugar to its destination would pay several times over for the bag. In this view of the innovation the bag really costs the trust nothing, but comes to its hand with a profit ready made. The barrel's successor is a plain burlap bag with a light muslin bag inside. This is the worst blow the local cooperage industry has ever experienced, and almost wipes out that business in Philadelphia. Flour now goes to Europe in bags, and is retailed in the same way. Sugars brought here from the West Indies and Hamburg come exclusively in bags, which, after being cleaned, are used up for paper stock. The Spreckels were the first to introduce the bag business in the East. The trust saw the advantage at once and took immediate steps to have its output shipped in the cheaper way as soon as it gained control of the refineries."

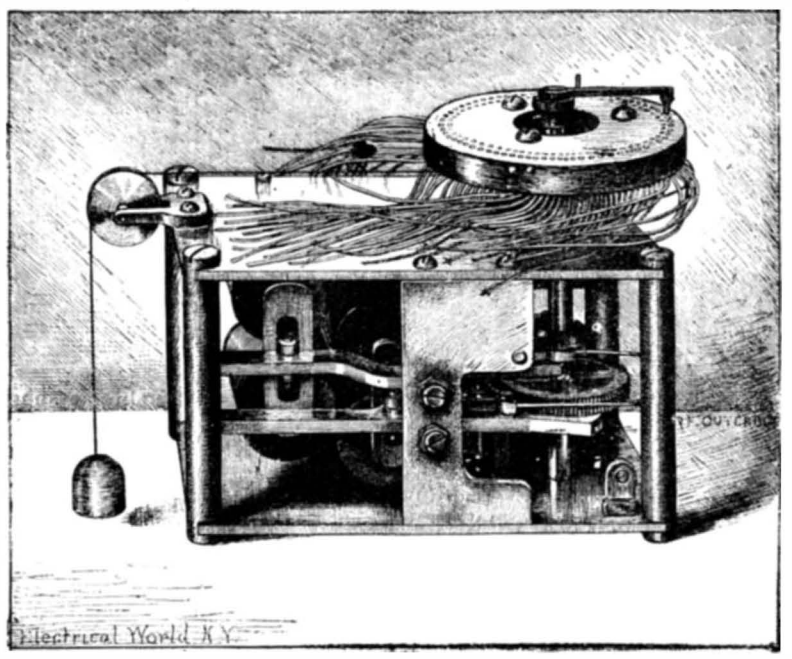

Fig. 2.—THE SWITCHING MACHINE

California Gold.

The days of rich pockets and nuggets are by no means over in California. For instance, a few weeks ago they got $10,000 out of a pocket in the Stow mine, Forbestown, Butte County, and the mine since made a clean-up of $20,000. Henry Miller, of Magalia, in the same county, found a little pocket in his claim from which he took out in a few minutes $580. Ed. Gilbert found in his drift mine, near Butcher Ranch, Placer County, a nugget worth $2,300. It was about ten inches the long way, from three to seven inches in width, and from an inch to an inch and a half in thickness. The whole surface was very irregular. Its beauty consisted of having the formation of crystallized quartz, with clear-cut corners, the sides of whose cubes shone with dazzling brilliancy at any angle from which a person viewed it. The mine has been worked more or less since 1856. Louis Page and partners at Bald Mountain, Tuolumne County, after working a tunnel for nineteen months, have struck several very rich pockets, where they have found nuggets worth $40, $80, and $140, and lots more in sight.

These are only a few instances seen in our exchanges in the past week or so, and there are, doubtless, others not chronicled. There are thousands of Chinese working in the mines of the State, but no one ever knows what they get; and in the richer claims run by white men little is said of the product. The gold mining interests of California are becoming better recognized than they have been of late years. The northern counties are only partly prospected, and even in the older mining regions there is room for discovery. There are many mines being worked steadily by private parties which are paying handsomely, but as no stock is for sale, very little is said of them in the public prints.—*Min. and Sci. Press.*

Fig. 3.—TELEPHONE CENTRAL OFFICE.

Preparation of Wool.

In all branches of the woolen industry it is an indispensable fundamental condition that the wools to be worked up are subjected to good factory washing, such as is generally known. The wool must be perfectly free from grease and suint and must after washing have neither a smeary nor harsh feel; after drying, when compressed in the hand, it must readily and with elasticity open (after quickly opening the hand) and expand like feathers.

For dyeing piece goods in light colors all wools are unsuitable which have a darker yellow or gray tint. For light, delicate colors are also all mixtures of art wools with other wools equally unsuitable, and finally a wool material is to be rejected which by various diseases of the sheep is contaminated with corruption, abrasions of skin, particles of blood, etc. Tar tips and seal wax from marking the sheep in the flocks are also apt to cause stains upon the goods. Defective wools and such as have no clear appearance are only suitable for dark colors.

The fulling is good only if, besides closeness of the felt, the washing is perfect, so that all alkalies and particles of grease have been removed from it.

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Correspondence.

A Natural Mathematician.

To the Editor of the Scientific American:

I notice in SUPPLEMENT 879 a table for finding the day of the week for any given date. The table is the simplest one I have yet seen, but it seems to me that there may be a still simpler one. The reason I think so is that there is a simple-minded negro man here named William Butler who can tell, almost instantly, the day of the week for any date within the last 300 or 400 years. He has been given numerous severe tests and has never made over one or two misses out of fully 100 trial questions put to him.

He evidently makes some sort of mental calculation, because he repeats a few words to himself rapidly and then gives the correct answer within five seconds. I have questioned him very closely to see if I could find out how he does it, but he is not possessed of sufficient intelligence to give any of his process. He says "he just knows it," but he is surely possessed of some short cut by which he readily computes the day of the week. He knows all about leap years and old and new style dates, but he cannot add up any figures mentally the sum of which will exceed 50 or 60. Experts have in vain attempted to find out his method, but while he is perfectly willing to talk about it, he can not give any satisfactory explanation of the matter. Is he a prodigy, or has he got hold of some short cut process? A. A. LEWIS.

Somerset, Ky., November 14, 1892.

The Brooks Comet.

To the Editor of the Scientific American:

The comet discovered by me on August 28 of the present year may now be easily observed with moderate size telescopes, and is gradually growing brighter. Found on the border of the constellation Auriga, the comet has moved through Gemini, Cancer, and Leo, at the date of this writing being about twelve degrees south of the bright star Regulus. Its direction of motion is southeasterly, which will carry it through Hydra, and early in December the comet will be found in the constellation Corvus—the Crow. From there it will move on toward the head of the Centaur.

As some readers may wish to pick up the comet, I give a few positions as follows:

	R. A.	Decl. south.
Nov. 20	10h. 40m.	5° 43′
" 24	10h. 59m.	9° 50′
" 28	11h. 20m.	13° 57′
Dec. 2	11h. 40m.	18° 00′
" 6	12h. 2m.	21° 50′

From these places the path of the comet may be readily traced.

Early in December the comet will be thirty times brighter than at the date of discovery, and will continue to increase in brilliancy until about the time of its nearest approach to the sun, on December 28. The object is an interesting one in the telescope, having a bright, starlike nucleus and a well developed tail.

WILLIAM R. BROOKS.

Smith Observatory, Geneva, N. Y.,
November 12, 1892.

Birds that Eat Acorns.

To the Editor of the Scientific American:

In the October 22 issue of this paper, page 257, was an article from *Science*, by Dr. Morris Gibbs, stating that the number of birds in Michigan that feed upon acorns is but six. These are the passenger pigeon, the morning dove, the white-bellied nut hatch, the crow blackbird, the blue jay and the red-headed woodpecker. I can add another to the list, though the incident that brought it to my notice occurred in an adjoining State. This is none other than the common wood duck, found in almost all, if not all, of the States.

About five years ago, while hunting ducks in Ohio, I came one afternoon to a little pond, frequented much by ducks. It was at the edge of a wood and a rail fence partly surrounded it. Several ducks flew up, apparently out of the wood, as I approached, and I sat down in a fence corner and waited for them to return. Presently they came back, and after a little circling lit upon the water. As they did not light close together, and I was only armed with an old musket, I concluded to wait until they would swim together, and thus get a chance to kill two of them or perhaps all. But they seemed to want to keep apart. I waited and waited, but not once could I get more than one in range. They just floated around a little, and occasionally tipped themselves up while reaching for something on the bottom. Other ducks circled around but did not light. The ones on the water still kept apart, and I began to think it would be one duck or none. I had waited almost an hour. Suddenly all three started toward my side of the pond, and when near the edge raised and lit on the fence just a panel from where I lay crouched. My heart sank, for I thought my last chance for a duck was gone. I was almost afraid to breathe as I looked up at them sitting almost over me and apparently looking right into my eyes. After sitting a moment and taking a hasty survey, they lit under a white oak tree, not thirty feet away, and commenced eating acorns, which lay thickly on the ground. They gobbled them up with the characteristic gobble of ducks while feeding. I was so surprised at first that I sat and stared at them, but recovering myself I fired at the one nearest me and killed it, a beautiful drake with feathers all variegated and golden. I hastily put him into my game sack and started for home, as it was getting late. On arriving there I examined him and found two acorns in his gullet about half way down, and, opening the crop, I found several more, all with the hulls entire. Little else was found in the crop, and I concluded that the acorns must have been one of their favorite foods, as there was plenty of duck weed in the pond and also a kind of grass seed of which they are very fond. Since then I have watched the wood duck, and often come upon them feeding on acorns under trees near some pond. But it is difficult for the hunter to get them then, as they immediately rise among the trees and prevent a good shot at them, and no doubt this is why others have not discovered their peculiar food and written of the subject sooner. GEORGE E. MCCULLOCH.

Fort Wayne, Ind.

The Oldest Herbarium in the World.

There is in the Egyptologist Museum at Cairo an inconspicuous collection of dried or artistically prepared parts of plants, which on more grounds than one is of universal interest. In the first place this collection constitutes the oldest herbarium in the world; it was collected from old Egyptian graves, and, at the suggestion of the former director of the museum, Maspero, they were submitted to the well known botanist and explorer, Dr. George Schweinfurth, for a thorough investigation.

As regards the significance of the use of plants in the death cult of the Egyptians, we must make a distinction between the edibles, which were ordinarily placed in earthen vessels on the floor of the sepulcher, and which were regarded as necessary adjuncts in furnishing the "eternal house," as the Egyptians characterized the last resting place of their beloved ones, and those symbolic death offerings which were designed to express reverence for the dead, especially in the higher sphere to which they were translated, and to which secret magical power was sometimes ascribed. Prof. Schweinfurth says concerning these death offerings, which consisted principally of wreaths and garlands of flowers:

"Here (that is in the coffins) we find lotus flowers fixed under the outer ties of the mummy wrapping, with whole wreaths and bunches on the side of the mummy, between it and the inner folds of the grave cloth, and also wreaths covering the breast of the mummy in concentric rows, or garlands twined about the head. These wreaths and garlands are characteristic in their arrangement and appearance, being such as are never found among any other people than the Egyptians. The limited space between the mummy folds and the shroud did not admit of making the wreaths as we make them. They had to be thin and flat. To this end leaves of leathery texture were taken, twice folded, and strung together with fibers of date palms to form little agraffes for holding small flowers or petals, which were here secured as in a vise. Finally fine strips of date palm ran through the whole lengthways, securing the perfectly flat wreath."

In this connection it may be remarked that the rarity of floral decoration was due to its costliness, which confined it mainly to the higher classes. People of small means had to content themselves with colored pictorial representations on the coffin lid.

While the long wreaths, together with the unarranged flowers and bunches of flowers, which were probably offered to the dear departed at the last moment before the coffin was closed, are traceable to the earliest times, the olive wreaths are not seen before the Græco-Roman epoch, and appear to have been introduced from Greece. Wreaths and garlands were not, however, wanting in a deeper symbolical meaning. To the latter especially certain magic powers were ascribed. After due preparation with prescribed formulas, they enabled the dead to remember the prayers and petitions necessary to his salvation, and further to present them acceptably, on which account they were frequently styled "the crown of the right utterance."

The most of the floral remains recovered from Egyptian graves are in an astonishingly well preserved condition, so much so that after treatment with warm water they can be handled like modern herbarium specimens. In some flowers the parts which were protected by an outer covering, pistils, anthers, etc., were, in spite of their extreme delicacy, perfectly intact. The preservation of the colors, too, is something remarkable. Apart from the fact that the colors are slightly faded they show no very remarkable variation from modern specimens. Some water melon leaves, even, by immersion in water showed that they still retained a portion of their green coloring matter (chlorophyl).

The most important matter in connection with such finds is unquestionably their age. We possess remains of funeral food from the fifth dynasty (3000 B.C.) The brick pyramids of Dalschur furnished a perfectly well preserved legume of clover (Medicago hispida), and a grave at Sakkara a handful of barley ears. The remains of the twelfth dynasty (2500 B.C.) are still richer in contents, for the recovery of which we are indebted to Mariette Bey's industry. Among the funeral food of that period we find grains of mustard seed, capsules of flaxseed, gourds, lentils, beans, figs, pine needles, juniper berries, etc. The most interesting and important acquisition to our herbarium, in so far as concerns leaves and flowers, was obtained from the mummy find of Deir el Bahari in 1881. The richest booty was yielded by the tombs of Ahmes I., Amenopeth I., and Rameses II., and generally from the eighteenth to the eleventh century B.C.

There is, however, a difficulty in determining the age of some of the most important flower discoveries with precision. Some of these very mummies were opened up and reswathed, from motives of piety, some five hundred years after they were first laid to rest: it is hence impossible to say whether the flowers date from the first or second period. But at the lowest estimate they are nearly three thousand years old, while the oldest herbarium in Europe is scarcely four hundred years old.

Among the flowers chiefly employed in floral decoration for the dead, we find the blue and white lotus, the red poppy, oriental larkspur, hollyhock, the yellow flowered Sesbania Egyptiaca, crown chrysanthemums, safflower, pomegranate flowers, willow leaves, grasses, etc. In the Græco-Roman period celery leaves came into requisition. In the coffin of the so-called Kent mummy (twentieth dynasty) celery was found mixed with lotus leaves and flowers. Onions, leeks, garlic, etc., played an important part also in the offerings to the dead.

The Egyptians further deemed it a duty to provide wine for the comfort of their dead. This was not, however, offered in liquid form. The wine berry was the usual medium in which wine was provided, while barley was provided to secure the deceased his modicum of beer.

As to the fertility of seeds taken from Egyptian coffins, a great many fables have obtained currency. The closest investigation has determined that the seeds were all kiln-dried and partially roasted before being applied to their destined purposes. All attempts to germinate grain taken from Egyptian tombs have been attended with negative results, and if occasionally some of the grain procured with a mummy find has been found fertile, it should be remembered that the Arabs, who do a large trade in mummies, are in the habit of mixing a little new wheat with the old on purely business principles.

One of the general conclusions to be drawn from this herbarium is that Egypt has sustained no appreciable climatic changes during the last 4,000 years.—*Paul Pasig, in Westermann's Monats-Hefte; The National Druggist.*

Fluorography.

Fluorography is a process that permits, through fluorated inks, of transferring lithographic or phototypic images to glass. In contact with sulphuric acid, these inks disengage hydrofluoric acid, which engraves upon the glass delicate images that one might say were traced by snow and hoar frost.

In order to obtain this artistic result, a phototype is inked with the following mixture:

	Grammes.
Glycerine	400
Water	200
Fluorspar	100
Tallow	100
Soap	100
Borax	50
Lampblack	50

From this proofs are taken that are transferred to glass in the same manner as would be done for transferring them to a lithographic stone. Then the glass is bordered with wax and covered with sulphuric acid concentrated to 64° or 65° Baume. At the end of about twenty minutes the acid is poured off and the plate is washed thoroughly with water and cleansed with a solution of potash in order to remove every trace of acid. Finally, another washing is given with water and the glass is wiped with a warm cloth.—*Le Genie Civil.*

ANOTHER great railway engineering achievement was recently accomplished in England. This was the piercing of the Totley tunnel on the Dore and Chinley Railway, the new line on the Midland system connecting Sheffield with Manchester. The tunnel, with the exception of that which runs under the Severn, is the largest in England, being a little more than three and one-half miles in length. Over 1,000 men have been engaged on the undertaking for the past four years, and considerable difficulties, caused by the presence of immense quantities of water, have been surmounted.

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The California Vine Disease.

The California vine disease is the name that has been given to a virulent disease attacking the vineyards of Southern California, and causing widespread destruction. The trouble seems to have been first noticed in the year 1885, in the vicinity of Anaheim; and it assumed serious proportions in 1886. In the fall of that year many vineyards were dead or dying, and the grape growers had become alarmed. In 1887 the United States Department of Agriculture sent Prof. F. L. Scribner to the region to look into the matter. Prof. Scribner was accompanied by Prof. Viala, an authority on vine diseases of France, but the time spent in the field was too short to permit of anything more than a general view. It was not until 1889 that the Division of Vegetable Pathology of the Department of Agriculture took charge of the investigation and sent a special agent into the field. This agent was Mr. Newton B. Pierce. There have appeared from time to time brief notices of the work of Mr. Pierce, but no detailed account has been published until within a few days. This detailed account is contained in Bulletin No. 2 of the Division of Vegetable Pathology, entitled "The California Vine Disease: a Preliminary Report of Investigations by Newton B. Pierce, Special Agent." It contains 222 pages, 25 plates, and 2 charts. The letter submitting the report being dated June 15, 1891, and that transmitting it April 15, 1892, shows a rather long delay in its issuance, due to causes incident to most government publications.

The report is a very full one. It treats first of the origin and growth of the early vine industry of Mexico and California, in the course of which it is shown that, although vines have been cultivated in Mexico for 350 years and in California for more than 100 years, no such disease or wholesale death of vines was known previous to 1885 or 1886, when the disease became prevalent at Anaheim. Even in the very spot where it first appeared, vines had been cultivated for twenty-five years without any serious diseases appearing.

Mr. Pierce then proceeds to give the characters of the disease as it affects the different parts of the vine. The leaves, for example, fail to develop chlorophyl in certain places, and they turn yellow or red, or else become spotted. The characters vary in the several varieties, and are well shown in several colored plates. The canes are found to ripen unequally, presenting patches of green and brown after the leaves have fallen. The roots, too, become rotten, the whole finally passing into a loose amorphous mass, and the epidermis can be easily drawn away from the xylem cylinder. The fruit dries upon the vine without maturing, and, even when reaching maturity, does not possess the sweetness it ordinarily should. The sap becomes deficient in quantity and the new shoots are brittle and can be readily broken.

Such are the characters of the disease as given by Mr. Pierce. He then proceeds to trace the gradual spread of the disease from Anaheim as a center, showing it to extend rapidly in all directions, and to soon cause all the vines within the affected region to die. One of the peculiar signs of a diseased condition of the vines is an increased yield of fruit. The amount is sometimes doubled or even trebled one year and then falls to less than half the amount which the vines would normally produce the following year.

In order to determine, if possible, the predisposing causes of the disease, various conditions were examined. In brief, it was found that variations in soil had no effect, the disease appearing on loose, gravelly soil, on sandy loom, or on heavy adobe soil. Elevation and slope, drainage (artificial and natural), irrigation or non-irrigation on uplands or lowlands, manuring, were each and all counted out as factors in the production of the disease. The influence of shade was found to be considerable, those vines exposed to the full effects of the sun succumbing sooner to the disease than those partly shaded from it. The origin of the shade was immaterial, there being no difference whether caused by deciduous or evergreen trees or by houses. This is an interesting fact as showing the cause, whatever it may be, to act more powerfully in the heat than the cold.

Studies of rainfall, temperature, and various other meteorological phenomena are considered to have no effect. So, too, various methods of cultivation, of pruning, of grafting, of planting healthy or diseased cuttings, seem to be unable to cause or modify the disease, although it shows itself sooner when diseased cuttings are planted than when healthy ones are used.

In the chapter dealing with the relationship of the disease there seems scarcely a point left untouched. The fungi affecting the roots, those attacking the foliage, the fruit and the canes, animal parasites (such as mites, nematodes, and insects of various sorts), are all examined. Non-parasitic diseases, such as chlorosis, pourriture, or decay of vine roots, mal nero, rougeot, and folletage, are also discussed. Mr. Pierce does not consider that mal nero, a serious disease of the vine in Europe, resembles the California disease, but rougeot and folletage present some analogies. Still there are not enough, beyond the coloration of the leaves (examples of which are shown in colored plates) to ally the diseases.

The last two chapters, containing remedies and suggestions for treatment and the general conclusions, are those to which many readers will turn with great expectations. Beyond reading of negative results, they will find but little. An account is given of many experiments made to prevent or cure the disease, but failure was the result in each case. The removal of all diseased vines seems necessary; spraying with Bordeaux mixture or eau celeste may have some effect in stimulating the vine, but cannot be regarded as a preventive; sulphuring is recommended, as well as using perfectly healthy cuttings in starting new vineyards. The effects of *Uncinula spiralis*, causing powdery mildew, should be further studied. Bacteriological investigations have not gone far enough to establish the fact of any causal relation to the disease, although forms of these micro-organisms have been found in the diseased vines. Finally Mr. Pierce sums up what may be said in relation to a disease-inciting agency as follows:

"(1) The observed phenomena would be mostly explained if we consider the disease to be due to an epidemic caused by an external parasite arising after the wet season of 1883-84, and spreading with greatest virulence from the vicinity of Anaheim. This parasite must be capable of working during the most heated portions of the year, and must exist at the present time, although working with less intensity than at first. *Uncinula spiralis* is the only parasite yet known in the region which even approximately satisfies these conditions, but more than normal virulence would have to be assigned this fungus to explain the observed results.

"(2) The observed phenomena would be in the main explained if there were a form of micro-organism within the vine capable of altering the normal physiological relations of the plant at the heat of the season, and which organism began to spread in the Santa Ana Valley about the year 1884.

"(3) A weakened condition of the cell contents, acquired under exceptional local conditions at some single period in the past, and which is persistent and cumulative from one hot season to another, would in part explain the observed phenomena. The objections to this explanation are: (*a*) The cause and nature of such a weakness are not fully apparent; (*b*) it does not account for the death of vines grown from unaffected cuttings since the disease appeared; (*c*) it poorly harmonizes with the health and normal productiveness of old vines for several years subsequent to the death of the first vineyards."

While Mr. Pierce in California has been studying this disease, others, in France, have been working upon an equally mysterious malady of the vine. According to published accounts, Mons. Viala and Sauvageau have been more successful than Mr. Pierce in ascertaining the cause of the disease. These authors state that, in studying a disease discovered in France, in 1882, and which caused the leaves to drop and the fruit to become wrinkled and dry, they discovered the reason to lie in a fungus allied to that producing club-root in cabbages. This fungus they named *Plasmodiophora vitis*. It occurs in the palisade tissue, and spreads from thence into surrounding cells. The plasmodium often looks like the cell contents proper, but eventually it breaks up into masses which look like oil drops, containing one or more vacuoles. No remedy is yet known. The interest of this in the present connection lies in the fact that in a later paper the same authors, in studying dried material affected with the California disease, conclude it to be caused by a fungus also, and they refer it to the same genus, under the name of *Plasmodiophora californica*. They do not know of any remedy, and it still remains to be seen whether study of further material will establish or refute their position. Meanwhile those whose vines are being destroyed by the unseen enemy await with anxiety some method of combating the mysterious foe.

JOSEPH F. JAMES.

Washington, D. C., November 11, 1892.

To Give the Appearance of Tortoise Shell and Mother-of-pearl to Horn.

Mr. Bloch, of Paris, has patented a process for giving objects made of horn the aspect of tortoise shell or mother-of-pearl by plunging them successively into an alkaline solution and a bath of a salt of lead. The objects, after a careful polishing, are immersed in a solution of carbonate of soda for a length of time sufficient to saponify the fatty matters, and are then washed with an abundance of water until there no longer remains either any fatty matter or soda upon the horn. They are then placed in water containing sufficient ammonia to render it feebly alkaline, until every bit of sulphureted product has disappeared. In this state the horn has absolutely the appearance of tortoise shell. If it is desired to give the objects the aspect of mother-of-pearl, they are immersed in a 15 per cent bath of nitrate or acetate of lead long enough to allow of the deposit of a thin layer of lead salt upon their surface. After being taken out of the bath, the objects are immediately washed with an abundance of water and then reated with a 5 per cent solution of hydrochloric acid, in which they are allowed to remain a sufficient length of time to take on the desired aspect of mother-of-pearl. Finally, they are polished and brightened with a buff-stick.—*Moniteur Scientifique.*

An Approaching Comet—Is it Biela's?

A comet, visible to the naked eye, and, on November 17, in the constellation Andromeda, is now approaching the earth. It appeared on that date more than double the size that it was when first discovered by Professor Holmes by photography at Lick Observatory, about midnight on November 6, occupying, on the 17th, thirteen minutes of the arc of which it at first sight occupied only five. Up to November 17, Professor Pickering, of Harvard, stated that its orbit could not yet be estimated. Immediately upon the discovery of the comet, Professor Pickering says: "We got two positions with our large telescope, and on the 9th we found the comet. It was observed about the same time by Professor Barnard at the Lick Observatory. On the 10th a telegram was received from Professor Berberich, of Kiel Observatory, announcing that its orbit was the same as that of Biela's. On the 13th a contradiction was made. Meanwhile we have been getting observations of its location in space. Our observations reveal this interesting feature, that it has apparently remained stationary. Some one has written a paper to show that the methods of computing motion by increase or decrease of brightness are incorrect. The fact that the Holmes comet is apparently about stationary goes to show either that it is approaching us directly or is moving slowly. This observatory is at present the only place where observations of brightness are being made. Hence we are particularly desirous that a bright comet should come. It is too early to determine how far off the comet will be when nearest the earth. Of course I cannot be positive that this is Biela's comet."

Biela's was a small comet sixty-six years ago, a short one, and remarkable for being a double one. It was discovered in 1826 by an Austrian officer, whose name it bears. Its periodic character was first detected by Gambart. Its orbit brought it within a few thousand miles of the earth. The comet returned in 1832. Then it was expected that an encounter with the earth would take place, which created a panic in the south of France. It passed the point where the expected collision was to occur a month before the earth arrived, and the nearest the two objects came to each other was fifteen million miles. In 1839 it was again seen. In 1846 two comets were seen to grow from one, the first recorded instance of the kind. The first discovery of the division was made in New Haven. For four months the pair traveled along side by side, 160,000 miles apart. Sometimes one was brighter than the other. On the night of November 27, 1872, there was a wonderful meteoric shower. In November, 1886, there was another, and it was concluded that the Biela comet was no more. That comet has been missing five times, and more than once under favorable conditions of visibility. It is once more the recurrence of its time, and perhaps it has flared up again for the final time, lighting its fires in honor of the Columbian period. Professor Pickering, besides observing the comet nightly with the 6 inch and the 15 inch telescopes, has been photographing it and its spectrum with the 11 inch and 8 inch glasses.

According to the calculations of Professor Boss, of the Dudley Observatory, the Holmes comet will be very near the earth on November 27 and 28, probably within 1,000,000 miles. From the calculations, the earth is due to arrive at the point where its orbit is nearest the track of Biela's comet on the evening of November 27, at 10 o'clock, eastern standard time. The comet is apparently due to arrive at that point on the morning of November 28; but, owing to the disturbances by the attraction of the planets which the comet has experienced, its exact course through space is not now known with sufficient accuracy to justify a prediction as to how near the comet will approach the earth. This must therefore be left to future observation and calculation. All that can now be said is that in case the Holmes comet is identical with the Biela's, its approach to the earth about November 28 will be much closer than in any other case on record.

Professor Boss estimates the distance of the comet from the earth, on the evening of November 13, to have been 13,500,000 miles. The comet then appeared as a large and bright nebulosity with well marked, though relatively faint, central condensation. The nebulosity was found to be nine minutes in diameter, and was much better defined on the eastern than on the western side. The nucleus, or central condensation, was small and elongated toward the east. The diameter of the nebulosity is estimated at about 36,000 miles, and of the densest part about 300 miles. There was no appearance of a solid kernel, such as is supposed to exist at the center of all great comets. Assuming the comet to be at the distance mentioned, any solid body at its center smaller than fifty miles in diameter would probably have escaped detection.

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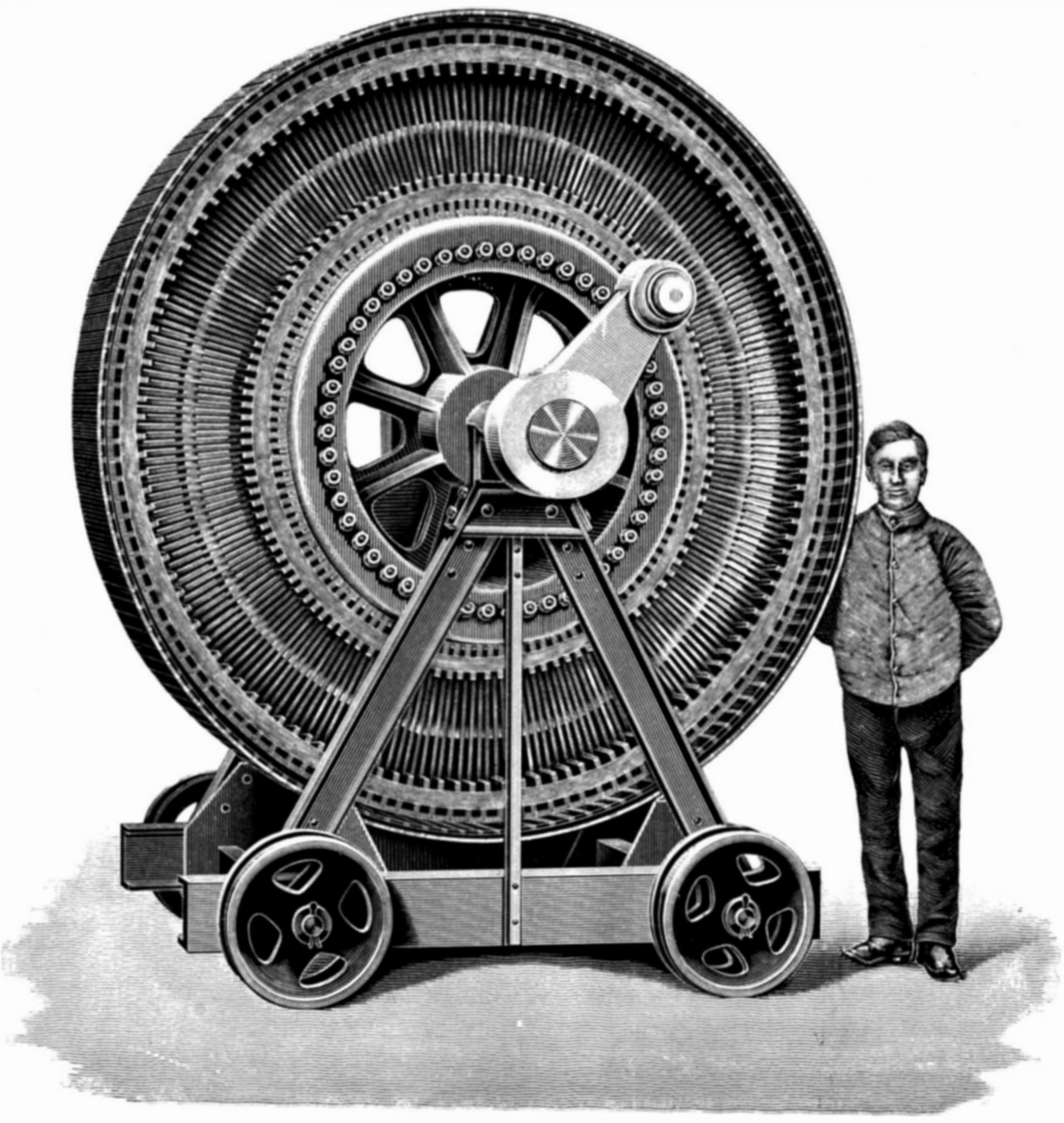
LARGE DYNAMO ARMATURE FOR DIRECT DRIVING.

Our engraving, for which we are indebted to *Industries*, represents a large Fritsche armature for direct driving, in which connectors are employed, and the armature strips proper are radial. The armature conductors are again connected up in series, and the method of coupling can be easily gathered from the illustration. We believe that Mr. Fritsche was the first to investigate the laws of the numbers of turns necessary to produce series winding in multipolar dynamos. The connectors in the radial armatures are of course copper, and as the iron conductors are naturally large in comparison, it is easy to fit the connectors in neatly. Messrs. Fritsch & Pischon, of Berlin, have now been manufacturing these machines for some time, and have made all sizes from 5,000 watts up to slow-speed direct-coupled dynamos giving 200 horse power each for central station work.



LARGE DYNAMO ARMATURE FOR DIRECT DRIVING.

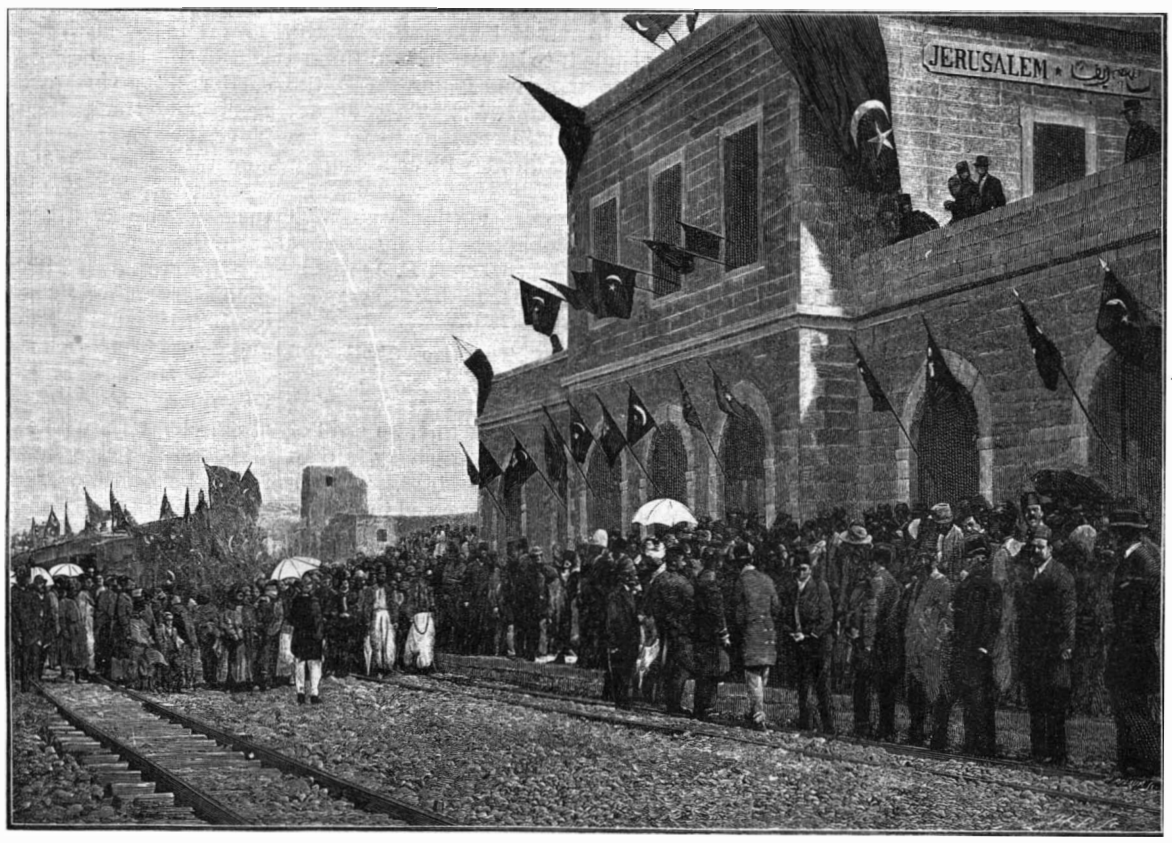
Veneering.

A very interesting process is the making of veneering. The logs are first steamed, then stripped of the bark and taken to the cutter. In the cutter, which resembles a large turning lathe, a long knife driven by machinery is made slowly to approach the revolving log, peeling off the veneer into long strips, the desired thickness varying from one-eighth to one-thirty-second of an inch. These strips are drawn out on a long table, cut and trimmed into the required sizes, and then are carried to the dryhouse. The veneer is dried in long racks, two strips being placed together, turned so that the frames are opposite, to allow a free circulation of air. After drying it is pressed and packed into bales.

THE JAFFA AND JERUSALEM RAILWAY.

The first railway line in Syria and Palestine, connecting Jaffa with Jerusalem, was opened on September 26, by the Governor of Jerusalem, Ibrahim Hakki Pasha, and by the Sultan's Special Envoy, Djelal Pasha, General and Aide-de-Camp of his Imperial Majesty, in presence of several distinguished officials of the Ministry of Public Works, who arrived purposely from Constantinople to witness the event, and to examine the works to see if the line were constructed in accordance with the plans and the terms of the concession. The president of the railway company and several other gentlemen and engineers arrived also from Paris for the occasion. All the inhabitants of Jerusalem and the neighboring districts gathered near the railway station; most of them were struck with amazement. A banquet was given by the railway company. The line is now open for traffic; two trains run every day from Jaffa to Jerusalem and the opposite way, passing by the towns of Ramleh and Lydda and several villages. Intending tourists may now be assured of finding comfortable accommodation on their journey to Jerusalem. Starting from Jaffa in the afternoon at two o'clock, they reach Jerusalem in three hours and a half, arriving in the Holy City before six o'clock in the evening.

In these days we consult Baedeker, who informs us that Jaffa, pronounced Yafa, is a town with some export trade in wheat, sesame, grain, oranges, silk, and soap; a landing place, of course, for thousands of Mussulmans, Jewish, and Christian pilgrims, the residence of a Turkish kaimakam subordinate to the Pasha of Jerusalem. The harbor, for small vessels only, is a basin formed by natural rocks under water and by the remains of ancient works of masonry; its northern entrance, by the mole or pier, is endangered by sandbanks, and that from the northwest is very narrow. Larger vessels and steamers anchor in the roads half a mile from the shore; passengers are landed by the boatmen. The town, built of tufa, with narrow, dusty streets, lies on a yellow beach, at the foot of a rock 116 feet high; to the north are orchards and palm trees. There is a Greek monastery on the quay, and a Latin hospice, founded in 1654, said to occupy the site of the house of "one Simon, a tanner"—but the Mohammedans claim this distinction for the site of a mosque near the Fanar, or lighthouse; an Armenian monastery, too, in which Napoleon, when it was a French military hospital, ordered the plague patients to be put to death by poison. At Jaffa, also, four thousand prisoners of war, by his order, were deliberately massacred. In the eighth century there was a Greek Church of St. Peter, on the supposed site of Tabitha's house. A German religious colony is settled at Sarona, two miles from the town. Joppa was occupied in the twelfth century by the knights crusaders, and was the scene of conflicts between Saladin and Richard Cœur de Lion. The distance southeast to Jerusalem, by the ordinary road, is about thirty-six miles. Ramleh and Lydda were towns of much note in the times of the crusades and of the Arab rulers of Syria. The city of Jerusalem has been often described.—*Illustrated London News.*



OPENING OF THE JAFFA AND JERUSALEM RAILWAY: THE NEW STATION AT JERUSALEM.

A New Color.

At a recent meeting of the chemical section of the Franklin Institute Mr. Palmer read a note on "A Lilac Color from Extract of Chestnut." In experimenting with a commercial extract of chestnut wood, with the idea of making galloflavine therefrom, an unlooked for result was obtained. The extract was somewhat fermented; that is, a part of the tannin had been changed into gallic acid; and the design was to convert this gallic acid into galloflavine by the usual method. A solution of the 51° extract was made strongly alkaline with potash, and subjected to the action of a stream of air for about ten hours. The temperature, meantime, was kept below 50° F. At the end of the period of oxidation, the potash was neutralized with acetic acid. The solution so obtained was tested for galloflavine by working therein cotton and wool yarns with the addition of potash alum. While no yellow color was obtained, a clear, bright lilac was developed on both the animal and the vegetable fiber. The body giving this color has not yet been separated from the oxidized extract.

DR. GEORGE S. ALLEN, of New York, in the *International Dental Journal*, recommends the use of a one to one thousand solution of bichloride of mercury in rosewater, as an elegant and efficient disinfecting fluid for instruments. Contrary to the common opinion that steel instruments suffer from the use of any solution of the bichloride, he finds that they remain perfectly unaffected after being dipped in it hundreds of times. By the use of rosewater the bug poison taste of the simple solution is entirely supplanted by an agreeable rose-flavored one. As the plain bichloride decomposes, he advises the preparation of a one per cent solution from the tartaric sublimate tablets, and the addition of 9 parts of rosewater to 1 of solution when it is wanted for the disinfection of instruments or for use in the mouth.

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Ordnance Notes.

The following are from the recent report of the Chief of Ordnance, General Flagler:

The German smokeless powder has the advantage of giving as good velocity as the French with a somewhat less charge. The German powder has the further marked advantage that it is readily made up into cartridges, while a great deal of time is required for putting up the French powder. The type 10 inch B. L. rifle has been fired to date 158 rounds and the type 12 inch B. L. rifle 64 rounds.

The department will have completed by the end of the calendar year 1892, fifteen 8 inch guns, eight 10 inch guns, and three 12 inch guns, which will be available for issue to the service as soon as the necessary carriages for mounting them are provided.

The extreme accuracy of fire is better illustrated by the statement that with the 8 inch gun in a target of five shots at a range of one mile, four out of the five shots struck within an area 20 by 21 inches, and in a target of eight shots at a range of 3,000 yards (about 1¾ miles) six shots struck within an area 1½ by 4 feet.

The test of the type 12 inch B. L. mortar, cast iron, hooped, has been completed by the board for testing rifled cannon, etc., and adjudged to be satisfactory for issue to the service.

The Stone Cutters' Strike.

A writer in *Stone* who is in a position to know, says that the granite cutters lost in wages and assessments during the recent long strike enough to buy and operate the leading quarries in New England. He estimates the loss to the strikers at $2,800,000, and his estimate is probably nearly correct. This shows pretty clearly where the strike hits hardest. The quarries are still there. The owners may have lost a portion of this year's profits, but they have lived comfortably and the strikers have not.

The above is from the *Brickmaker*, and if the figures are true it might be a good idea for the cutters, the next time they contemplate a strike, to put their heads and money together and buy out the works. They can then regulate their own wages and hours, and arrange everything else exactly to suit themselves, besides enjoying the satisfaction of having no boss to watch and direct their work.

How to Color Lantern Slides.

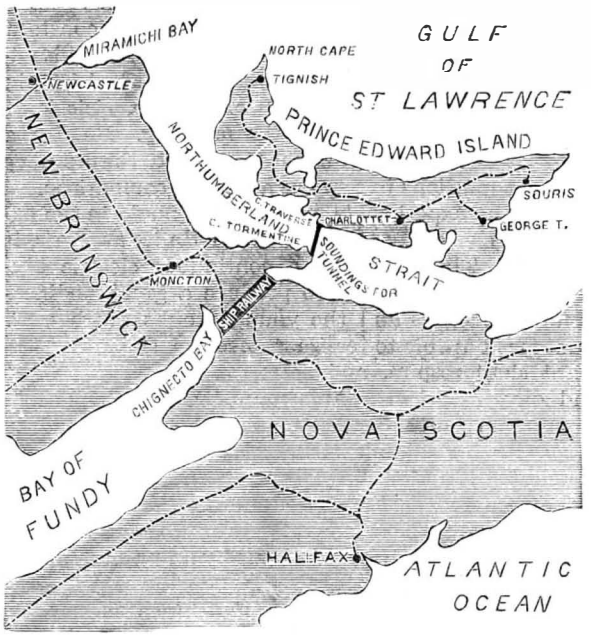
Procure an assortment of Judson's liquid dyes of suitable tints, a small quantity of spirits of wine, not methylated, and some camel hair pencils, small paper stumps, and a piece of glass to do duty as a desk. I may here say it is of no use trying to mix the dyes like other color in order to make certain tints, for one color seems to destroy the other instead of forming a tint midway between the two. The dyes must therefore be used alone, diluted more or less with spirits of wine, and one tint allowed to dry before another is applied. The principal difficulty is in avoiding the thickening of color at the edges of the stroke, but with a little practice this is easily overcome. Begin with the most delicate tints first; in a landscape, the sky and water, finishing with the more pronounced colors. A drop or two of a suitably colored dye being put into a small saucer, add sufficient spirit to dilute it to the proper tint, having at hand a little plain spirit into which the brush can be dipped as occasion may require. Owing to the volatile nature of the medium, promptitude must be used to avoid waste, or the different tints may be kept diluted in small bottles.

Suppose we desire to tint a moonlight scene with good clouds, and bright reflections on the water, a cottage with the windows illuminated, or lanterns hanging to the rigging of ships. First take a small stump, dip it into a solution of wax in benzole, or suitable greasy matter, going over all parts carefully that have to remain colorless. The windows and lanterns having been tinted yellow or red, let these be waxed also. The slide then may be bodily immersed in weak greenish blue dye; blot off the edges and dry. This will be probably all that is required to complete the picture. With a daylight view, tint the sky pale blue, softening off the color toward the horizon with plain spirit. Then carefully go over the landscape with suitable tints, always putting on the lightest and most delicate first, and drying before the application of the darker greens, etc. It is best to use but little color, slightly tinted pictures having the best effect on the screen. Simple as this process is, excellent results may be obtained with little practice. Some colors are apt to dry duller than others. When this is the case a little gelatine solution poured over will restore the brilliance, care being taken to avoid dust in drying.—*E. Dunmore, Br. Jour.*

PRINCE EDWARD ISLAND TUNNEL TEST.

It sometimes happens that an engineer by a simple, bold expedient revolutionizes certain engineering processes, and not only greatly reduces the cost of construction, but renders possible either a new class of work or develops a new phase of work in well known lines, either of which could not have been successfully carried out by the old methods.

Examples of inventions of this class will occur to the

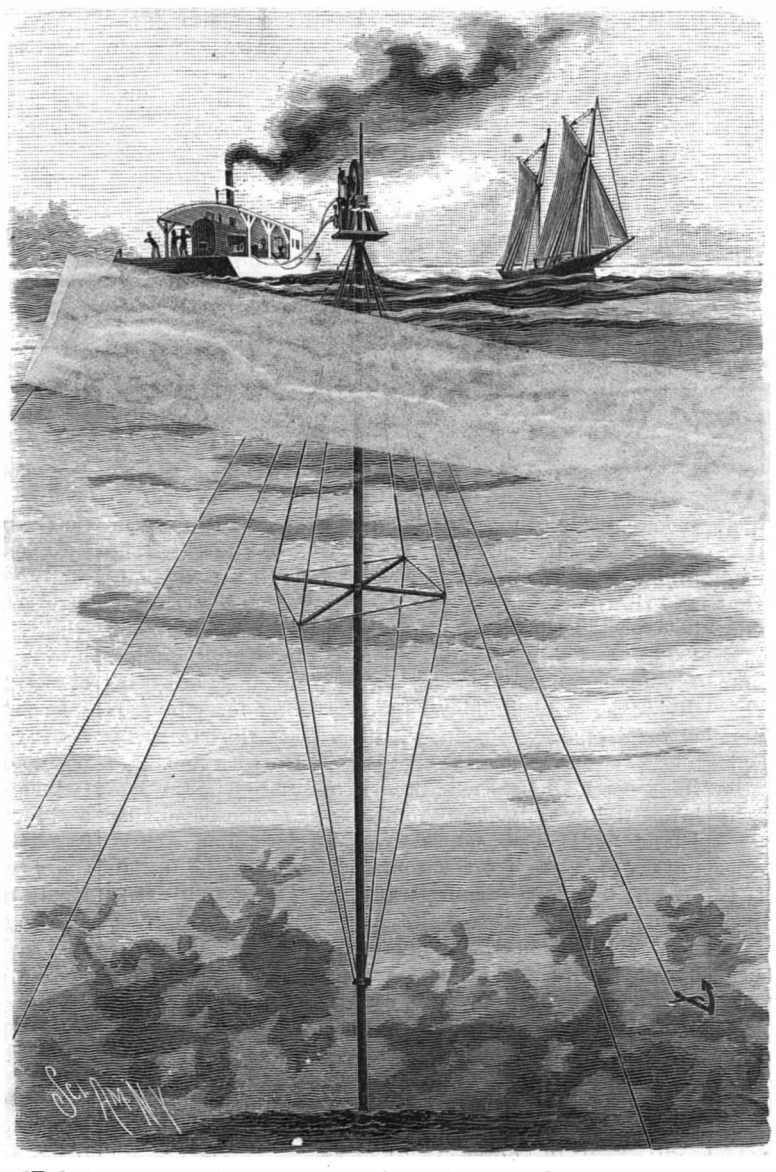


ROUTE OF PRINCE EDWARD ISLAND TUNNEL.

reader, and we now have to add to the list the record of an engineering feat which, in the boldness of its conception, the simplicity of the devices by which it was executed, the success attained, as well as the bearing of the work on associated interests, will compare favorably with any engineering work of like magnitude.

The work contemplated was the construction of a tunnel between Prince Edward Island and New Brunswick, as shown on the annexed map, the distance being eight miles. The problem presented was that of testing the nature of the earth between the proposed termini of the tunnel; but the Straits of Northumberland being perpetually stormy and the depth of the water being more than one hundred feet, the problem was not so simple as it might appear.

Our engraving illustrates the way in which the feat was accomplished. The method and apparatus are the invention of Mr. Alfred Palmer, C.E., of the Mills Building, in this city. A four-inch wrought iron pipe made up of 20 foot lengths rests upon the bottom of the sea, and upon the upper end of this pipe, which reaches above the surface of the water, is arranged a platform on which is mounted an engine running at a high rate of speed. The pipe is trussed to make it rigid and it is supported in an upright position by means of four wire ropes set out at right angles to heavy anchors. The engine drives a diamond drill at the rate of 1,000 revolutions per minute. A scow anchored near the pipe carries a 10 horse power boiler and other necessary machinery, the boiler being connected with the drill engine on the upper end of the pipe by means of flexible tubing. Another flexible tube supplies water to the drill for lubricating purposes. By means of this arrangement the drill is always held in a vertical position, and is not subject to any vertical or lateral movement, although the scow carrying the boiler and pump may be tossing about in a heavy sea. The current in the channel offers a resistance to the pipe of 36 pounds to the square foot, but it is so thoroughly braced and stayed that it easily resists this pressure.



TESTING THE GEOLOGICAL FORMATION OF THE PROPOSED ROUTE OF THE PRINCE EDWARD ISLAND TUNNEL.

The tests made indicate that the formation is highly favorable to tunnel construction. The contract for the tunnel is being carried out under the direction of the Dominion government, represented by Hon. George E. Foster, Minister of Finance, Mr. Collingwood Schrieber, Chief Engineer, and Sir Douglas Fox, Consulting Engineer, of London. Mr. Alfred Palmer is reporting engineer for Sir Douglas Fox.

An Historian's Brain.

The late Mr. George Grote, the historian of Greece, expressed in writing, eight years before his death, a desire that after his decease his cranium should be opened and his brain weighed and examined. The task was undertaken by the late Prof. John Marshall, and the results of his observations are set forth in a full report printed in the current number of the *Journal of Anatomy and Physiology*. The entire encephalon, says *Nature*, was somewhat above the average in size, if compared with the adult male brain at all ages. If allowance be made for the effects of senile wasting, it must be regarded as a rather large brain, but not as an actually or especially large one. There can be no doubt, however, that it was, at death, further diminished in size and weight through the effects of disease, as shown by its marked deviation from the ordinary ratio as compared with the body weight. As tested by the standard of macrocephaly adopted by Welcker, its utmost allowable weight was below that standard; and as contrasted with the encephala of certain other eminent men, it would find its place about one-third up from the lower end of the list. The general form of the cranium was rather or nearly brachycephalic, but it was decidedly higher than usual. The cerebrum itself was, in accordance with the shape of the cranium, short, broad, and deep. The cerebral convolutions were very massive, being not only broad and deep, but well folded, and marked with secondary sulci. This condition was observable all over the cerebrum, but chiefly remarkable in the frontal and parietal regions. Studied in reference to Dr. Ferrier's researches into the localization of function in the brain, the relative size of certain convolutions or groups of convolutions suggested some reflections as to individual peculiarities, but these reflections did not seem to Prof. Marshall to be quite trustworthy. From the size and richness of the convolutions, the sufficiency of gray matter, both on the surface and in the interior of the hemispheres, and from the remarkable number of the white fibers, especially of the transverse commissural ones, the brain of Mr. Grote is pronounced to have been of very perfect and high organization.

Mirage.

A beautiful and instructive lecture experiment, illustrative of the conditions of the heated atmosphere which give rise to the mirage, says *Nature*, is described by MM. J. Mace de Lepinay and A. Perot, in their "Etude du Mirage," which appears in the *Annales de Chimie et de Physique*. Water is poured into a long rectangular trough, with glass sides, and covered with a layer of alcohol about two centimeters thick, containing a trace of fluorescence. After a few hours, during which the alcohol diffuses slowly through the water, a flat beam of light is sent through the mixture at a very slight inclination to the horizon. Under these conditions a kind of garland of light is seen to traverse the liquid, due to a series of curvilinear deflections or "mirages" in the less highly refractive water below and total reflections at the upper surface of the alcohol.

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Natural History Notes.

Migratory Crabs.—In the West Indies there exist crabs that are both marine and terrestrial. These crustaceans, according to the *Revue des Sciences Naturelles Appliquées*, always reproduce their species in the sea, but, in the adult state, frequent the shore, and, like the fish of the deluge of Deucalion, spoken of by Horace, make their way to the summit of high mountains. Once a year a curious instinct leads them to emigrate by thousands toward the sea, whither they go to deposit their eggs. They travel as far as to the roadstead of Port Royal (Jamaica). Advantage is taken of this passage of the crabs to capture them. Many of them contain magnificent corals. Their flesh, besides, is highly esteemed in the Antilles. Their young pass their larval state in the sea, wherein they swim about freely, and afterward pass through a fresh water and terrestrial stage.

The Torpidity of Fish under Ice.—The *Zoologische Garten* gives an account of some recent observations that have been made upon the resistance of fish confined under ice. It was already known that the carp (*Cyprinus carpio*) loses the power of motion when the temperature of the water descends below 4° C. In the recent experiments, from twenty to thirty specimens of the following species were taken in the month of January: The common minnow (*Phoxinus lævis*), the gudgeon (*Gobis fluviatilis*), the bleak (*Leucaspius delineatus*), and the loach (*Cobitis barbatula*). These fish were put in the open air into wide-mouthed vessels, whose bottoms were covered with a layer of earth. After a continuous period of cold, these vessels became covered with ice reaching a thickness of several centimeters. The fish were soon observed to turn over, some upon the back and others upon the side, and remain motionless. It was remarked that the chromatophores, especially in the minnow and loach, had become more intense than at the epoch of spawning. All the animals appeared to be dead, but after a hole had been made in the ice they soon began to move their gills, at first slowly, and then more rapidly. It was not till after several hours, when the water was warmed, that they regained their ordinary vivacity.

Hairs and Feathers.—A remarkable speculation that necessitates further independent research appears in a recent number of the *Morphologisches Jahrbuch*. As is well known, it is the common belief that the hairs of mammals, the feathers of birds, and the scales of reptiles are all epidermal structures of a fundamentally identical character; but after an elaborate study of the growth and development of these several protective coverings, Dr. F. Maurer, of Heidelberg, now arrives at the conclusion that hairs are, in every respect, distinct from feathers and reptilian scales. He considers that they are homologous with the sensory points in the skin of the amphibia, or, at least, that they are outgrowths from these points as bases. Referring to the fact that the characters of the integument are of importance in classifying the great groups of vertebrata, Dr. Maurer thus concludes that his researches confirm the supposition that the mammalia are derived directly from the amphibia, and have not had any reptilian ancestors.

The Ascent of Sap in Plants.—A problem familiar to all students of botany is that relating to the ascent of water in plants. Text books explain the phenomenon in more or less plausible ways, and doubtless it may be news to many to be told that they know nothing about it.

The latest and perhaps the most thorough investigation in this direction is that by Professor Strasburger, of the University of Bonn. In the recently issued record of his latest physiological work the present aspect of the question is clearly put. It is shown that experiments in the "ringing" of plants had no other result than to again prove that the water current is conducted through the wood. The living alburnum in this alone is functional, but it is not admitted that living cells have any share in the process. Then, again, though facts seemed conclusively to indicate that the current passes through the cavities of the tracheæ, the theory that the protoplasm assists the passage of the water, by its contraction or by its influence on osmosis, had to be rejected as untenable. The evidence all appears to favor the conclusion that the ascent of water in plants is a purely physical process. That it is not a vital one was proved by the ability to cause an upward flow in plants previously killed by various methods. The conditions necessary for the ascent of liquid are stated to be that the cell walls should be in a state of imbibition, while the tracheæ are within certain limits filled with water and isolated from the air. The learned professor definitely disposes of some time-worn explanations when he states that atmospheric pressure simply helps to keep the water suspended, that the only importance of transpiration in this connection is that it makes room for the ascending fluid, and that root pressure is not immediately concerned in the process at all. Capillarity has long been known to be insufficient to account for the phenomena, and the net result of the research is that we are left in the position of knowing nothing whatever concerning the cause of the ascent of sap in plants, save that the process is a purely physical one.

Influence of the Electric Light upon Plants.—Knowing that the cultural experiments made with the electric light have had as a special object the general development of plants, Mr. Gaston Bonnier has, in some investigations undertaken by him, endeavored to ascertain what modifications of anatomical structure it would be possible to obtain by submitting plants to a light of sensibly constant intensity. Two lots of similar plants were submitted, one of them to a constant electric illumination and the other to the same illumination from six o'clock in the morning to six o'clock in the evening, and then to darkness from six o'clock in the evening to six o'clock in the morning. Finally, a third lot was submitted in the open air to the ordinary normal conditions to serve as a term of comparison.

From the experiments, which were made in the pavilion of electricity of the Central Halles at Paris, it results: 1. That, through a continuous electric illumination, it is possible to produce a great modification in the leaves and the young trunks of trees. 2. That it is possible to realize a medium such that the plant shall respire, assimilate, and transpire, night and day, in an invariable manner, the plant then seeming as if incommoded by such continuity and its tissues having a simpler structure. 3. That discontinuous electric illumination (with twelve hours of darkness out of the twenty-four) produces in the various organs a structure that more closely approaches the normal one than that brought about by an uninterrupted electric light.

The Feeding Habits of Serpents.—Since the month of August of 1885, the Garden of Plants, of Paris, has been in possession of a South American boa (*Boa murinus*), which has been the object of some interesting observations on the part of Mr. Vaillant, especially as regards its alimentation.

This serpent is at least twenty feet in length. From the time of its reception by the garden up to the end of the year 1891 it has taken food thirty-four times, that is to say, on an average of five times a year, the interval between its meals varying from 28 to 204 days. The animal regulates its own meals, manifesting its hunger by a characteristic uneasiness. Its food has almost always consisted of goats of small size, although on three occasions it has taken rabbits, and on one occasion a goose. The largest animal that it has swallowed is a kid weighing 26 pounds, representing about a sixth of its own weight. It is well known, however, that serpents are capable of swallowing animals almost as large as themselves, and at the menagerie of the museum, a few years ago, a horned viper was caught in the act of swallowing a French viper, its companion in captivity, which was a little larger than itself. The horned viper did not appear in any way to suffer from its meal. As for the digestive function, that is relatively rapid, for the residua of it are generally evacuated at a single time, after each meal, and at the end of but a few days.

The Double Cocoanut Palm.—After many failures, the horticulturists of Kew have succeeded in growing a young "double cocoanut palm" (*Lodoicea seychellarum*). The plant is a native of the Seychelles, and very rarely seen in cultivation. The germination of the double cocoanut occupies nearly two years, and its attainment to maturity is very slow. Its peculiar mode of germination is a source of great difficulty in cultivation. The radicle grows down from the large, heavy seed in the form of a stout tap root, carrying with it the stem bud or plumule inclosed in the sheath of the cotyledon. By the ultimate splitting of the latter the plumule is set free and able to ascend. If this long and slowly-growing process be injured, success cannot be expected. The trunk of the adult tree may reach 100 feet in height, though scarcely a foot in diameter. The male and female flowers are borne on separate individuals. The immense fruits average forty pounds in weight; they contain, within a thick fibrous husk, one, two, or sometimes three large nuts, with hard and thick black shells, each divided about half way down into two lobes. Before the discovery of the Seychelles Islands, in 1743, considerable mystery attached to these nuts, which were often found floating in the Indian Ocean (hence the name "Coco de Mer"), and highly prized by the natives of the Archipelago. Rumphius, in his "Herbarium Amboinense" (1750), speaks of the nut as "hujus miri miraculi naturæ, quod princeps est omnium marinarum rerum, quae rarae habentur." It is not, he says, a terrestrial fruit which has happened to fall into the sea and thus become petrified, as Garcias ab Orta would persuade us, but a fruit actually growing in the sea, the tree being hidden from the human eye. He mentions some curious fables in connection with it, and says there are many more not worth the telling.

In olden times important medicinal virtues were attributed to the fruits of this magnificent palm, water drank out of vessels made from them being supposed to preserve people from all complaints, and extravagant prices were consequently paid for them. At the present day they are converted into various domestic utensils, while the wood serves for many useful purposes, and the leaves are made into hats and beautiful baskets, cigar cases, etc., besides being used for thatching.

The reprehensible practice of destroying the trees for the sake of their nuts will, it is to be feared, lead to the extinction of the coco de mer, which will become in reality as rare as it was supposed to be by the voyagers who picked up the first known specimens of the nuts floating on the sea.

The Distance to which Bees Fly.—Insect Life says: However difficult it is to determine the rate of speed of bees, and hence however erroneous any calculations based upon such determinations may be, it is not at all difficult to tell practically how far bees actually go after honey. *Apis Mellifica* has been introduced into regions where the species did not exist before, and careful observations have been made regarding the range of its flight, and also the yellow varieties have been taken to countries or localities where only brown or black bees were found, and the dark varieties have been experimented with in regions where only yellow bees were natives. In this manner it has been readily and accurately determined that they generally work within a distance of 2 miles from their hives, although they will in rare instances go as far as 4 or 5 miles, and a resident of an island off the coast of Texas reported, several years ago, having followed his bees in a boat, and found them working on the mainland, a distance of 7 miles from their hives. But no practical bee keeper would expect favorable results from pasturage located over 3 miles from his apiary, and marked advantage can only be awaited when the honey sources are located within 2 miles in a direct line from the apiary.

A New Industry for Mexico.

It is stated that C. P. Huntington, of the Southern Pacific and Mexican International Railways, has purchased the Cerro Mercado, of Durango, Mexico, and that he intends to erect a large steel and iron plant near Durango City. This Cerro Mercado is an immense mass of iron ore, one mile long, one-third of a mile wide, and rising from 400 to 650 feet above the level of the plain on which it is situated. Its existence has been known for many years. It was discovered by the Spanish early in the sixteenth century, and in 1558 an expedition was sent out to examine it, owing more to the rumors that it contained large bodies of gold and silver ores than from any belief that an iron property, however rich, could be profitable at that time. No discoveries of the precious metals being made, it was abandoned for the time being, and it was not until after the independence of Mexico was declared that an English company acquired the property and the right to establish iron works on it, when actual development work and the production of pig iron was commenced on a comparatively large scale.

Previous to this a small quantity of malleable iron was produced by the agriculturists of the vicinity, metallurgists for the time being, in small Catalan forges.

Weidner, who examined the property for the Mexican government in 1858, estimated the mass to contain 250,000,000 net tons of 50 per cent ore, and Mr. John Berkinbine, the eminent authority on iron, while disagreeing with Weidner's extravagant estimate, pronounced the deposit to be "the most extensive known single deposit of iron ore on the American continent, or, possibly, in the world." He is inclined to the belief that the Cerro Mercado consists of one or more lenses of specular iron ore standing nearly vertical, the walls of which cannot be observed, owing to the detrital *talus* at the bottom. An average of all the samples, from about 10,000,000 square feet of surface, analyzed by McCreath, gave metallic iron 55·8, manganese 0·079, sulphur 0·085, phosphorus 1·328. Selected specimens showed but 0·003 phosphorus, and Mr. Berkinbine thinks it not improbable that large quantities of Bessemer ore could be mined.

In late years the property has been in the hands of American capitalists, who, it is to be regretted, have not made any profits on their investments, but this is to be ascribed rather to the want of fuel and the small and local demand than the failure of the deposit itself to meet the requirements of a successful venture. At the present day the conditions are changed, as the Mexican International Railroad is at Durango. Instead of being obliged to rely upon the insufficient supply of charcoal brought in by the burro load, coke of fair quality can be hauled to Durango by rail, and the production instead of being limited to the requirements of the immediate vicinity can be extended to supply the entire republic.—*Eng. and Min. Jour.*

The Yard Measure and the Meter.

The true equivalent of the yard measure in terms of the meter is found by Professors Comstock and Tittman, of the United States Coast Survey, and by Dr. Peters, of Germany, director of the International Committee of Weights and Measures, to be 39·3700 inches. The correction is 0·0008 of an inch, the value found by Kater and Arago in 1818, and in vogue since that year, being 39·3708 inches. The corrected measure, 39·3700 inches, will, it is expected, duly become the recognized standard.

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IMPROVED WINDING GEAR FOR SEVENTY-FIVE TON SHEAR LEGS.

The accompanying illustrations show the machinery for a set of shear legs for lifting seventy-five tons, and a general view of the shear legs and machinery. The specification states that the machinery was to be capable of lifting: (1) 75 tons at 2 ft. per minute on the larger barrel; (2) 30 tons at 6 ft. per minute on the larger barrel; (3) 10 tons at 12 ft. per minute on the smaller barrel. For 1 the motion is conveyed from the engine shaft through a double set of spur wheels and pinions to a worm and worm wheel, the latter being keyed to the same shaft as the larger barrel; for 2 the motion is direct from the engine shaft to the worm and worm wheel and larger barrel; for 3 the motion is from the engine shaft to a bevel wheel and pinion on a secondary shaft, at right angles to the engine shaft. At the other end of the secondary shaft is a spur pinion keyed to the shaft, and gearing with a spur wheel keyed to the same shaft as the smaller barrel.

The shaft carrying the smaller barrel is fitted at its outer ends with warping drums keyed to the shaft, and the barrel itself runs loose upon the shaft, being connected to, or disconnected from, the driving shaft by means of a clutch. When disconnected from the shaft, any load upon the barrel can be held, or lowered, by means of a hand brake and foot lever, and the warping ends can be worked by steam independently of the barrel. Both barrels are of sufficient size to take the total lengths of rope required by the specification without overlapping. Among the details it may be mentioned that the engine—two-cylinder horizontal type—is fitted with link gear and steel motion rods. The worm is of steel turned from the solid, and runs in an oil trough; all forgings are of steel; all the wheels are of cast steel; and the thrust, as well as all the other bearings, is fitted with heavy gun-metal bushes.

The machinery has been designed and manufactured for a foreign dockyard by Messrs. Baxter, engineer contractors to the Admiralty and foreign governments, of Sandiacre, Nottingham.—*The Engineer*

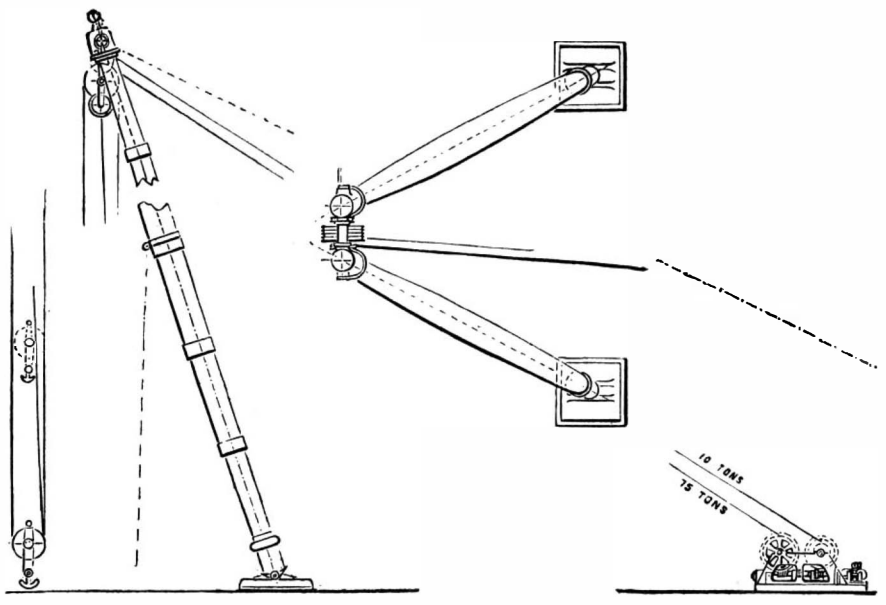


DIAGRAM OF SEVENTY-FIVE TON SHEAR LEGS.

A Substitute for the Nasal Douche.

Dr. Bloebaum no longer uses the nasal douche in removing crusts from the nasal cavity. He simply twists a long and thin roll of cotton on a knitting needle, introduces it into the nose, and withdraws the needle, leaving the cotton in the nose. A second and third are introduced thus, until the entire cavity is filled. Then one may begin with the opposite side and do likewise. In the course of a quarter of an hour the mucous membrane begins to secrete profusely, and if the cotton is then removed it will be found that it is saturated with secretions, and the crusts lie on the rolls of cotton, thus leaving a nicely cleaned cavity for the application of the remedies. He never employs any watery solutions, but salves, which are rubbed into the nasal mucous membrane, or powders, which are insufflated.—*Lancet-Clinic.*

Mixtol: A New Developer.

The name of mixtol has been given to a developer containing hydroquinone and eikonogen. Here is the formula and the order in which the author recommends making this solution:

Sulphite of soda	120 grammes.
Hydroquinone	15 "
Eikonogen	10 "
Yellow prussiate	20 "
Carbonate of potash	75 "
Caustic potash	15 "
Bromide of potassium	1 gramme.
Boiling water	1,000 c. c.
Glycerine	10 drops.

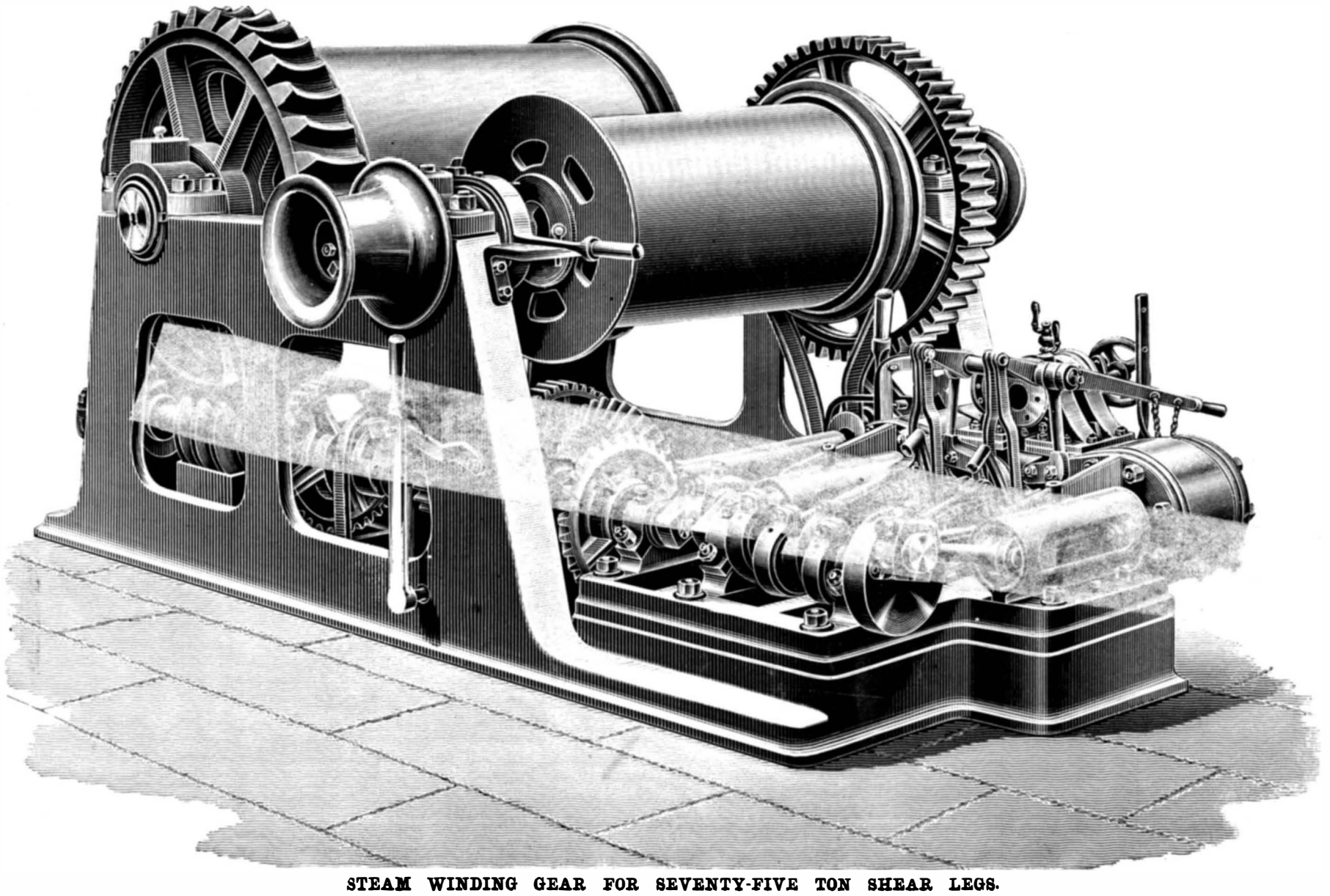
Care must be taken to operate on a slow fire, and to wait until each salt is well dissolved before adding the other. This solution, when filtered, is of a beautiful yellow color, and of perfect transparence. It keeps well. For instantaneities, add one-half water; for time negatives, two-thirds, or, better, do away with the potash and increase the quantity of carbonate of potash to 95 grammes. If necessary, add a few drops of a solution of bromide of potassium at 10 to 100. The author says that it stains neither the plate nor the fingers, that it never detaches the gelatine, that it acts rapidly, yielding vigorous negatives without being hard, full of details in the half tones. Several plates may be developed in the same bath—thus 70 c. c. of the developer and 70 c. c. of water were sufficient to develop twelve instantaneous plates 9 by 12 centimeters; the first required three and one-half minutes, and the last eight to ten minutes. None acquired a yellow color; all were good, and the bath was hardly deeper in color than the new bath.—*La Nature.*

Lead as a Tooth Filling.

Dr. S. S. Davidson, of Ottawa, in the Dominion *Dental Journal*, says:

"On June 14, a physician practicing in Ottawa, and well known for his hunting propensities, came to my office to have a lower wisdom tooth treated. After this was accomplished he asked me if there were any other teeth in that vicinity that required treatment. Examining the second molar, I found what I thought to be an amalgam filling in the grinding surface, which had the appearance of years of service. I remarked that the filling in this tooth was still giving good service. He declared he never had a tooth filled, and never before had required the services of a dentist. Upon closer examination I found the cavity filled with a grain of No. 4 shot. This had been jammed in so hard that it completely stopped the opening to the cavity. Around the edge an oxide had formed, and to all appearance was preserving that tooth as well as the most carefully inserted gold filling. The only way the worthy doctor could account for it was in eating a tempting morsel of wild duck, of which he is very fond. The shot being embedded in the meat had crowded into the cavity unknown to him and there remained. Strange to say, he would not have it removed and replaced by a more costly filling, remarking 'That is good enough for me.'"

THE General Electric Company now has establishments at Lynn, Mass., Schenectady, N. Y., and Cleveland, Ohio, and employs upward of 15,000 men. The rise and growth of electrical industries in this country is something astonishing.



STEAM WINDING GEAR FOR SEVENTY-FIVE TON SHEAR LEGS.

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RECENTLY PATENTED INVENTIONS.

Engineering.

GAS ENGINE EXHAUST FURNACE.—Hippolyte J. Seigneuret, Henderson, Minn. This engine combines a gas engine and a steam engine in a manner designed to utilize the heat of the products of combustion in the former to propel the steam engine. The gas engine is placed in the water space of the boiler, and arranged to exhaust into the fire box or combustion chamber, the parts of the engine which do not admit of being placed under water being set up outside the boiler. The gas engine may be of the ordinary construction, and both boiler and engine may be vertical or horizontal.

WATER INDICATOR FOR BOILERS.—William H. Rodgers, Bay Side, N. Y. A receptacle containing an expansible liquid or gas, and provided with a diaphragm, is supported by a shell, through which it is connected with the water column of a boiler, a lever being fulcrumed on the diaphragm and another lever on the support, there being also a connection between the diaphragm and an alarm mechanism, by which an alarm will be given when a predetermined quantity of water is in the boiler or when a certain degree of temperature is reached. The device is of simple and durable construction, readily applicable to any boiler, and without the inclosing tube may be used as a thermostat in factories, greenhouses, hotels, mines, etc.

WATER ELEVATOR.—Rufus W. Tinsley, Union, S. C. An apparatus adapted to raise water by the automatic pressure of the water within two cylinders is provided by this invention. The cylinders each contain a reciprocating piston having a valved water-conducting tube of less diameter attached to its upper side, through which tubes water is forced up as the piston descends. Water is alternately admitted to and cut off from the respective cylinders, and is thus forced alternately up the respective piston tubes, the weight of the column of water in each tube above its valve balancing the column in the other tube, whether the tubes are rising or falling.

POWDER MOTOR.—George V. Sheffield, New York City. The driving shaft of this motor is connected with a piston over which slides a carrier block in an inclosed chamber, the block having a central chamber and a series of passages in alternating connection with a furnace through which passes a firing pin into the block, while a reciprocating hopper above the block supplies measured quantities of the explosive compound in accordance with the adjustment of a time connection. The arrangement is such that the application of the power of the powder to the pistons may be made in a safe and effective manner, a uniform charge of powder being afforded for each explosion.

Railway Appliances.

CAR COUPLING.—Horatio G. Wood, Newport, R. I. Combined with a slotted drawhead and a vertically movable pin having a rearwardly extending arm is a swinging weighted lifting lever pivoted in the rear of the pin, the lever having its lower end adapted to extend into the path of a coupling link, while its upper end is recessed to receive an arm of the pin, there being a crank mechanism to operate the lifting lever. The device is simple, strong, and cheap, and may be used with any of the common link and pin couplings, enabling the cars to be automatically coupled on coming together, while the uncoupling may be effected from the top or sides of the car.

CAR COUPLING.—Melvin T. Miles, Le Mars, Iowa. This is a simple, strong and automatic coupling, of such form that an ordinary link may be used to connect two of the improved couplings, or to couple the improved device with an ordinary bull nose coupling of the link and pin type. At the rear of the drawhead aperture is a disk-like pivoted coupling dog having a toe formed by cutting away part of the disk, there being a pin rearward of the toe, while a notched crossbar is adapted to lock or release the dog by its sliding movement, there being means to move the bar longitudinally.

PNEUMATIC CAR BRAKE COUPLING.—Rufus W. Tinsley, Union, S. C. Combined with a coupling head having valves and a bracket attached to the car frame and a vertical slot, is a spring attached to and supporting the head, with means for securing it to the slotted bracket, and adjusting it higher and lower. The coupling and uncoupling of the air pipes is, with this improvement, effected automatically, the attention of a train hand not being necessary, the air pressure instantly forcing the valves to their seats when the coupling heads separate, so that escape or leakage is prevented while the cars are uncoupled.

STREET CAR.—John E. Foster, Monmouth, Ill. At the car end are two doors hinged at their inner edges, one swinging inward and the other outward, and outside of these is a vestibule whose floor is below that of the car, with sliding doors one on each side of the center. The passenger stepping into the vestibule is safe, no matter how suddenly the car stops or starts, and it is designed to have passengers enter by the right hand door and leave by the left hand door, permitting loading and unloading without any crowding.

Electrical.

AUTOMATIC ELECTRIC SCALE. — Paul J. Kuhbacher, Ashland, Ky. This is an improvement in track scales for weighing railroad cars and their contents, but applicable also to other purposes. The poise is attached to a flexible connection running parallel to the scale beam and passing around pulleys, the connection being moved to adjust the poise by an electric motor. The field magnets of the motor are fastened to the short end of the scale beam and carry the armature at their lower ends, the weighing being effected automatically as the load is placed upon the scales and the weight recorded by printing at the same time.

Mining.

ORE CONCENTRATOR. — Thomas T. McNary, Hailey, Idaho. Within a suitably constructed casing having at one end a hopper through which the material to be treated is discharged is a series of V-shaped connected channels, each formed at its apex with a transverse slot, a pipe connected with the water supply discharging the water under pressure into the slot. The construction is simple and inexpensive, and is more especially designed for separating the sand from the precious metals, to prepare the ore for the jigs and tables.

ORE SEPARATOR.—Carl A. E. Meinicke, Clausthal, Prussia, Germany. This is an ore sizing or grading apparatus in which an ascending column of water separates the valuable material and passes it through different channels, according to its size and weight. Combined with a hopper discharging into a vertically arranged channel into which open one or more inlets at one side, is a series of branch outlets on the opposite side of the channel, located one above the other, an overflow being arranged above the uppermost branch outlet.

Agricultural.

PLOW. — Marcus L. Battle, Cairo, Ga. The share of this plow has an independent blade and point, and a shoe is provided for connecting the two sections. The construction of the shoe is such that blades of different widths and degrees of curvature may be employed in the formation of the completed share, to turn the earth more or less over. The improvement also provides an adjustable landside with cutters adapted to cut under plants or weeds and sever their roots, the whole construction being very simple and the plow being readily adapted to various kinds of work.

BUTTER WORKER AND WEIGHER. — Thomas Muir, Margaretville, N. Y. This is an improvement on a former patented invention of the same inventor, providing a new construction of bowl and form of working lever or cutter, with devices to facilitate the free rotation and transverse movement of the lever, means for draining the bowl, and means for utilizing the bowl as a scale platform in weighing butter. Combined with the bowl is a vertical standard hinged at its lower end, a working lever or cutter having a universal connection with the standard near its upper end, whereby the downward pressure of the worker exerts an upward pulling strain upon the swinging standard.

Mechanical.

POWER TRANSMITTER.—William Larson and Ole Gunderson, Lake Mills, Iowa. This is a simple and durable construction, more especially designed for converting the reciprocating motion of a windmill rod into a rotary motion. Three parallel shafts on which are ratchet wheels are mounted in a frame and geared together, there being also parallel arms on the shafts provided with pawls engaging the ratchets, while projecting from these arms are other arms whose adjacant ends are clamped to a head.

DISK HOLDER FOR VALVES.—John W. Randall, New York City. The valve casing, according to this improvement, is formed with an inwardly extending annular flange, on which is seated a ring on top of which is a metal disk having a projection fitting into the ring, a cap screwing in the casing on top of the disk. The valve is simple and durable, the seat opening being left totally unobstructed when the valve is unseated and the fastening device being prevented from becoming accidentally unloosed or detached.

Miscellaneous.

CASH REGISTER AND ADDER.—John E. Claudin and Paul Robert, Roanoke, Ill. This is a machine designed to accurately indicate at any time the amount of the contents of the drawer in connection with which it is used, being an adding machine as well as a cash register. Preferably the machine is without casing, but has a box-like frame with top and bottom plates, in which are journaled vertical spindles each carrying a dial with numbers on its face, the dials being moved by shifting arms with handles and pointers. The machine is designed to register from cents up to hundreds of dollars, and the invention covers various novel details and combinations of parts.

SHADE AND CURTAIN FIXTURE. — James H. Herring, Murphy, Texas. A simple, practical and efficient device is provided by this inventor to afford adjustable support for a window shade and also for a curtain pole, whereby the curtain and shade may be together lowered to permit the free entrance of light or air from above. It is a supporting and retracting device consisting of vertically sliding bracket boxes on strips fixed to the stiles of the window casement, an adjusting cord hanging from the lower end of each box, by means of which the height of the curtain roller and shade may be adjusted as desired.

BOTTLE FILLING APPARATUS.—John Jackson, Lonsdale, R. I. Connected with a receiving trough are delivering or filling tubes, each holding just a sufficient amount of liquid to fill a bottle, and each tube is provided with a valve, the stems of all the valves being connected with a frame actuated by a valve lever, by the moving of which in one direction or another all the valves are opened or closed. By this means a number of bottles may be simultaneously filled without spilling any of the liquid, whether or not the bottles be transparent.

MUSICAL INSTRUMENT. —Alexander Gylfe, South Bend, Washington. This is an instrument of the violin and guitar class, with a central sounding board having a transverse strengthening rib and sounding holes, while there are sounding ports between the board and the belly and back of the instrument. By placing such a sounding board in the body of the instrument, it is designed to greatly increase the sound, at the same time making it sweeter and softer.

MOUTH HOLDING APPARATUS. — Howard M. Casebeer, Lincoln, Neb. This is an appliance for dentists and surgeons, to be applied to the head of a patient to hold the mouth open as desired and allow of easy respiration. A spring-clasp support adapted to be sprung upon the patient's head is connected at one side with an adjustable holder extending forwardly along the jaw, and having at its forward ends members with mouthpieces to engage the upper and lower teeth.

RUBBER DAM CLAMP.—Christian A. Meister, Allentown, Pa. This is an improvement on a former patented invention of the same inventor, providing for the raising and lowering of one jaw relatively to the other in spring clamps mostly used on bicuspids and incisors. The improved construction is such that the clamp may be conveniently used without producing much or any pain on teeth of different kinds or of different heights on their outsides or insides.

SURGICAL ANTISEPTIC THREAD HOLDER.—Norman White, Bay Ridge, N. Y. In the neck of a suitable jar is fitted a disk or plate from the under side of which depend spindles carrying the thread bobbins, immersed in the antiseptic liquid, the ends of the thread passing up through a central tube. The jar is designed to accommodate bobbins for several sizes of thread, and in being drawn out the thread passes through a recess filled with wax, whereby the fluid held on the thread is wiped off.

EAR WIRE FORMING DEVICE.—David Mendelson, New York City. The shaping of wires by hand by means of pliers into various kinds of loops for ear ornaments is designed to be superseded by this invention, which presents a cheap and simple device, to be held in the hand or secured in a vise, and by which ear wires or loops may be quickly and accurately made. An arm held to slide on a plate or bed has its upper end bent to engage the wire, while a forming cam is secured adjacently to the arm, and forming pins project from the bed, the position of the pins being changed according to the shape to be given to the wire.

DUST SEPARATOR FOR FLOUR MILLS.—Frederic E. Duckham, London, England. This invention covers a method of and apparatus for separating the dust or stive from the air coming from grain milling machinery, and consists in providing an atmosphere of greater density into which the grain and dust laden current is projected in the form of a jet across an open space into or against the atmosphere of greater density, whereby the grain and dust are separated from the air current.

OPERATING SLIDING DOORS.—James A. Gatfield, Durham, Canada. This is a device for automatically closing and opening doors, whereby, when a cashier stands in front of his desk window or other opening closed by a sliding door, the latter will be opened automatically, and will close the moment the cashier leaves the window. A pivoted platform has a lever connection with the shutter to open it and an automatically operating latch mechanism to lock the shutter against opening when the platform is relieved of pressure.

CONVERTIBLE CARRIAGE, CHAIR OR ROCKER.—Nathan Silverson, New York City. This invention covers a composite construction which may, without the use of tools, be interchangeably converted into a spring carriage, a rolling chair, a rocking chair, a stationary chair and a child's high chair. Combined with two separably hinged body sections, one having a seat-back and side arms, are two forward, bent springs, a single transversely extending bent rear spring, two axles, four wheels, two flexing reach bars, and means to detachably secure the top of the rear spring to the rear body section. The invention also covers various other novel details of construction and the combination of parts.

PRINTING PRESS ATTACHMENT.—Emil Meier, New York City. In a press having distribution rollers contacting with a reciprocating inking table, a bar is pivoted at one edge of the table to contact with the rollers, preventing the table from striking the rollers at an angle, and thus chipping them. The bar moves in unison with the table and is arranged to conform at once to the angle of the rollers, and bear against them throughout their length, whereby the shock of the moving table will come bodily upon the rollers.

BRAID CASE.—Charles F. Sundstrum, Michigamme, Mich. This is a cheap and simple case for holding a large quantity of braid in such a manner that it cannot be soiled or injured, displaying the braid to advantage and still keeping it covered, while the whole or any portion of the braid may be easily removed when necessary. The rolls of braid are mounted on spindles fitting snugly in cylinders, there being behind the rolls in each cylinder a spiral spring pushing the rolls forward, so that one may easily grasp a roll and pull it off the spindle.

CIGAR CASE.—John O. Ullin, Ludington, Mich. This is a longitudinally opening and closing case adapted to hold a partly burned cigar, and having internal knives or cutters for severing the burned end of the cigar when the case is shut.

GAS TIGHT BARRELS, KEGS, ETC.—August Werner, Brooklyn, N. Y. A vessel which will be completely air and gas tight, and is designed to preclude all leakage when filled with a fluid under pressure, is provided by this invention. The staves and heads are each made in sections, and strips of flexible material placed between the sections, thereby forming a continuous intermediate layer of flexible material within the body of the staves and heads.

AXLE NUT.—Joseph Bermel, Middle Village, N. Y. This nut has opposite interior lugs which receive lugs on the reduced end of the axle upon which the nut is to be fitted, the nut being locked upon the axle instead of being screwed on it. The improved nut is strong, inexpensive, and presents a neat appearance, and when applied to the axle will remain in position as first put on, no matter how much wear and jarring the axle is subjected to.

THILL COUPLING.—William H. Pardee, Antigo, Wis. The coupling bolt of this device is adapted to extend through the clip lugs and thill knuckle, a head plate secured to the bolt having arms to clasp one of the lugs, while a face plate receives the bolt and fits against the opposite lug, there being a spring connection between the head plate and face plate. With this device the coupling may be quickly effected, and all side motion and rattling are practically obviated.

WATER CLOSET ATTACHMENT.—Isaac A. Martin and Charles T. Hammon, Ouray, Col. This is a portable device in which, in connection with a fluid receiving compartment, is a compartment for receiving and distributing a disinfectant quickly and conveniently when necessary.

DESIGN FOR PERFUMERY HOLDER.—John E. Warren, Jr., Newark, N. J. This holder is essentially in the form of a lamp post, with a suitable base at its lower end and the ordinary street lamp casing at the upper end.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

MANUAL OF QUALITATIVE BLOWPIPE ANALYSIS AND DETERMINATIVE MINERALOGY. By F. M. Endlich, S.N.D. New York: Scientific Publishing Company. 1892. 8vo. Pp. xv, 456. Cloth. Price $4.

There is no one who is better qualified to write a work upon this subject, Professor Richter excepted, than his pupil Mr. Endlich. The value of any work on analysis depends to a great extent upon its arrangement, and in this book the arrangement is essentially new, and the various tables, as well as all enumerations of mineral species have been carried out in alphabetical order whenever possible. The need of a work which could be used both for self-instruction and by the student working under the direction of a teacher has long been evident, and the present work was written by the author with both ends in view. Not all of the known or described mineral species are included in the tables, as this would only lead to inevitable confusion, but all those which are of value and liable to be met with are treated in a very satisfactory manner. The work is a valuable contribution to the literature of the subject.

SCIENTIFIC AMERICAN BUILDING EDITION.

NOVEMBER NUMBER.—(No. 85.)

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1. Elegant plate in colors, showing a very handsome block of residences near Riverside Park, New York City. Floor plans and two perspective elevations. Lamb & Rich, architects, New York.
2. Plate in colors showing a colonial residence at Cranford, N. J. Perspective views and floor plans. Cost $6,000 complete. Mr. Oscar S. Teale, architect, New York. An excellent design.
3. A summer cottage at Asbury Park, N. J. Perspective view and floor plans. Cost $3,400 complete. C. M. Dissosway, architect, New York.
4. A pretty cottage erected at Dubuque, Iowa, at a cost of $1,650. Floor plans, perspective, etc.
5. A double dwelling house erected at Springfield, Mass., at a cost of $10,495 complete. Mr. B. H. Seabury, architect, Springfield, Mass. A model design. Floor plans and perspective.
6. A "Queen Anne" cottage erected at Cranford, N. J., at a cost of $5,350 complete. A unique design. Perspective elevation and floor plans. Charles G. Jones, architect, New York City.
7. A residence in the "Old Colonial" style of architecture, erected at Oakwood, Staten Island, N. Y. Two perspective views and floor plans. Cost complete $4.515.
8. St. James' Lutheran Church, New York City. A striking piece of architecture in Romanesque Gothic, cruciform, pure ecclesiastical style. Cost of building and rectory $80,000. Mr. William A. Potter, architect, New York City.
9. A residence recently erected at Asbury Park, N. J. Floor plans and perspective elevation. Cost $6,750 complete. Mr. J. W. Roberts, architect, Newark, N. J. An excellent design.
10. Perspective and plans of Roble Hall, girls' dormitory, lately erected at Stanford University, Cal.
11. Decorative paintings from the Royal Academy, 1892.
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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(4594) W. F. W. says: Will you kindly advise me through the columns of the SCIENTIFIC AMERICAN in regard to a rule or formula for calculating the velocity or discharge through small openings? What is the discharge per minute in cubic inches through a hole one thirty-second inch diameter with a pressure of 90 pounds per square inch? A. The formula for the theoretical velocity of a stream or jet from a small hole in a thin plate is $v = \sqrt{2g \times h}$ = feet per second, $2g$ being twice gravity, 64·166, and h the height or head of water due to the pressure, or 2·3 feet for each pound pressure. This gives a velocity of 6,918 feet per minute for 90 pounds pressure. The area in decimals of a foot multiplied by the velocity in feet per minute gives the volume in cubic feet per minute. The area being for one thirty-second of an inch equal to 0·000767 of a square inch multiplied by the velocity $6918' \times 12 = 83016'' = 63$ 67 cubic inches per minute as the flow from the orifice. The actual discharge from friction and contraction will be about 63 per cent of the above quantity.

(4595) A. L. writes: I notice in your issue of November 5, 1892, an answer to Mr. E. Kurtz's question, "Why are stereoscopic prints reversed?" You say that Fig. 3 is transposed prints. But they do not appear as they do in Fig. 1. I think there is some mistake. Be kind enough to straighten me out. A. If "A. L." will carefully read the article to which he refers, he will find this statement with reference to Fig. 2: "Each tube of the stereoscopic camera inverts its own view; therefore, when these pictures are turned a half revolution in their own planes, as shown in the second engraving, they represent the image formed in the camera; and, consequently, the negative as seen from the glass side, also the print from the negative. By placing this double picture right side up, it will be seen that the images have been transposed in the camera in being inverted." It is obvious that these transposed pictures must be again transposed to bring them into the proper position as shown in Fig. 1.

(4596) J. H. M. says: The sewer running from my dwelling in this city to the street main became stopped up, and when the obstruction was removed, we were very much amazed to find that it had the appearance of being a vegetable growth. The entire pipe for a distance of several feet was filled with what seemed to be a mass of small roots one-tenth inch to much less diameter. The pipe had not been used for two or three months. I am quite certain that there are no crevices in it. Once or twice, a year or more ago, there was a back water from the main street sewer. The part of the pipe where the growth occurred was many feet underground and the whole yard where it runs is covered with concrete. I am anxious to know if you are acquainted with such a thing, how I am to prevent it in future, and where it is likely it came from. The plumber thinks it will grow again. A. The vegetable growth (algæ) is well known to take place in closed pipes containing water that cannot be aerated. A closed sewer pipe is liable to this growth as well as the dead ends of our supposed pure water supply, which, if left over a summer without blowing off, is sometimes found so crowded with algæ of the stronger growth as to be removed with difficulty without opening a full flow at head pressure. It will grow again next season, if the sewer pipe is not often flushed out. The use of more water in household work, and an occasional hot water washout will keep the sewer pipe clear.

(4597) N. Y. Z. says: Will you give a recipe for making the gelatine-like sheets which are in a duplicator for duplicating handwriting, typewriting and ink drawing? A. Hektograph sheets.—Soak 4 parts of best white glue in a mixture of 5 parts of water and 3 parts of solution of ammonia, until the glue is soft. Warm the mixture until the glue is dissolved and add 3 parts of granulated sugar and 8 parts of glycerine, stirring well and letting come to the boiling point. While hot, paint it upon white blotting paper with a broad-copying brush, until the paper is thoroughly soaked and a thin coating remains on the surface. Allow it to dry for two or three days, and it is then ready for use. An aniline ink should be used for writing, and before transferring to the blotting paper, wet the latter with damped sponge and allow it to stand one or two minutes. Then proceed to make copies in the ordinary way.

(4598) J. D. says: I have a building I want to heat with exhaust steam. Will you please answer the following questions through your paper? Will it heat the building as well or better by carrying the pipes overhead or along the wall close to the floor? Will it heat the building as well or better by starting at the top floor and working down, or starting at the bottom floor and working upward? Which is the best size of pipe to use? The exhaust pipe from the engine is 4 inches. How high do the pipes need to be above the boiler to trap the condensed steam back into the boiler? We are manufacturers of plows, and would like to know what is the best material or mixture to make hard and tough cast iron. Please give me your opinion as to the best way of heating a building by exhaust steam. A. Overhead piping for exhaust steam heating largely in use now for factories and machine shops. The radiant heat of the larger exposed surface by this system seems to make a heat energy felt in all directions, that does not take place from pipes partly hidden by benches and machinery, placing the coils flat overhead at an average height of 8 or 9 feet, or as far below the ceiling as circumstances will allow, facilitates the convection of heat by the free circulation of air through the spaces between the pipes. This is considered the best system, wherever it can be properly applied. It is better to commence feeding the coils as near the engine as possible, as it makes less back pressure than to carry the exhaust to the top and feed downward. A proper lay out of the plan should give all the coils an equal share of the steam. The best size of pipe for small factories is 1¼ inch, with each coil fed from the main exhaust, and of a size that all the coil connections shall have an aggregate area equal to or greater than the main exhaust. The drips should be gathered and led direct to an open tank to separate the oil before being pumped back to the boiler. The water from exhaust steam should not be trapped back to the boiler. No. 2 pig iron, with from 30 to 50 per cent of good scrap, makes a good mixture for plows. The coils for heating should be made with branch tees to lessen the length of circulation. For details, see Baldwin's "Book on Steam Heating," $2.50 mailed.

(4599) E. E. B. asks: 1. Can old crucibles be used over by crushing them up fine, and mixing cement with and forming them over again? If so, what kind of cement? A. The parts of old crucibles that are free from the melting flux can be ground and mixed with fine porcelain clay, remoulded, dried and baked. 2. Also tell me what they mix with silver ore to get the silver out by melting. A. The fluxes for silver ore depend somewhat on the composition of the ore. The sulphur should be roasted out and the ore reduced with a flux of soda and borax. See Eissler's work on the "Metallurgy of Silver," $4.25 mailed.

(4600) P. B. asks: What style of pump and power would be most suitable to raise water from wells, one 60 and the other 160 feet deep? How many acres of land can, under ordinary circumstances, be irrigated by means of an ordinary windmill, and how large would tank for reservoir have to be? Who is considered the most skilled and renowned sculptor in the world? A. You will require what is called a deep well pump. If a dug well, the pump cylinder should be placed in the line of pipe within 20 feet of the bottom, with the pump rod on the inside of the pipe and pipe stayed by cross timbers down the well, the pump chamber of any capacity to suit the requirement or flow of well. If a bored or pipe well, the chamber must be restricted to the size of the well pipe and the whole suspended from the top. The water required for irrigation depends entirely upon the climate or the degree of drought. A 16 foot mill will usually take care of 2 acres. A 25 foot mill 6 acres, with a lift of about 15 feet.

(4601) R. G. P.—There is no easy way of increasing the gloss on your celluloid collars. The manufacturers finish hair collars in such a way that they may be taken for linen. Remove grease spots with benzine or naphtha.

(4602) W. E. Y. asks: If a gas on expanding does external work, will it require as much mechanical energy to reduce it to its original bulk as though it had expanded without doing any external work? Also where can I procure a gauge or manometer for measuring pressures up to 1,200 pounds per square inch? A. The work of compressing a gas is the same, whether it has done work in expanding or not. The variation of temperatures for given volumes is the same for compression as for expansion. You may obtain high pressure gauges from Schaffer & Budenberg, John Street, N. Y.

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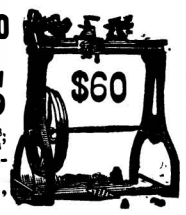
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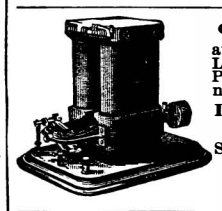
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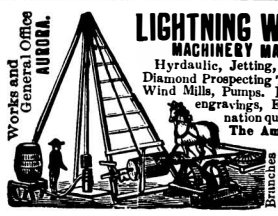
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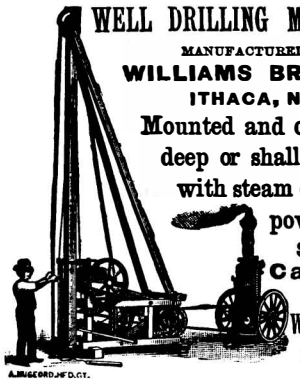
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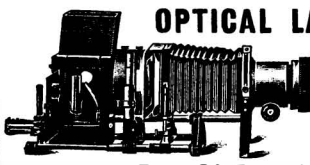
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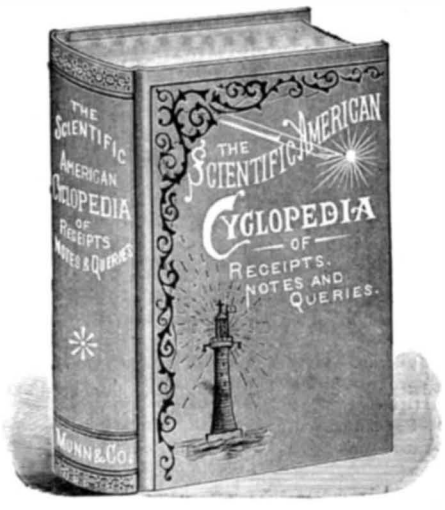

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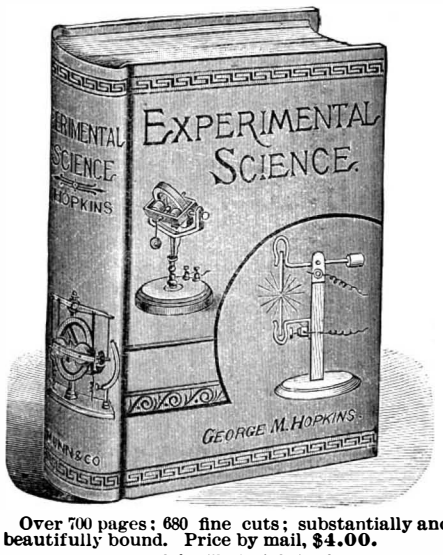

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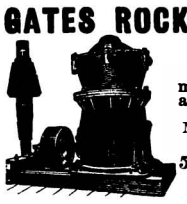

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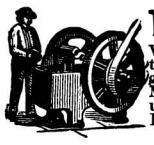

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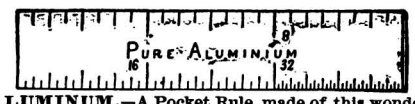

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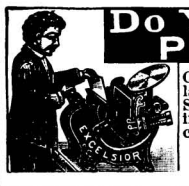

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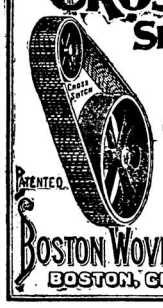

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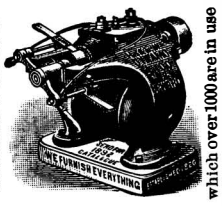

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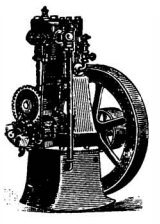

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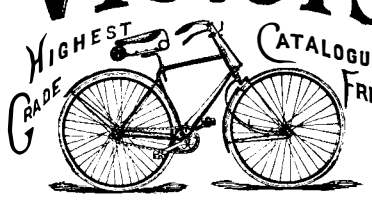

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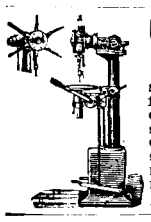

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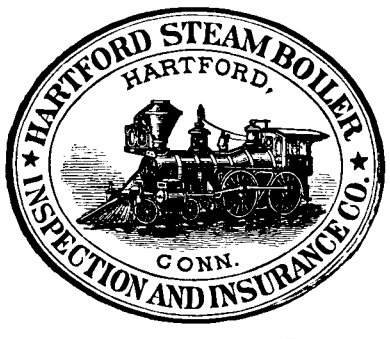

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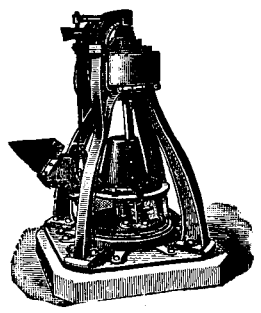

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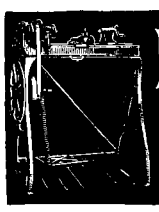

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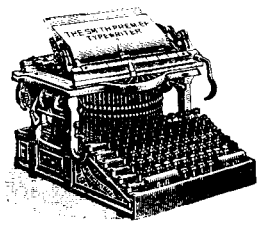

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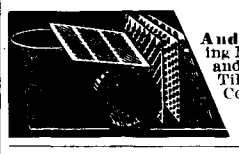

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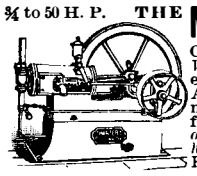

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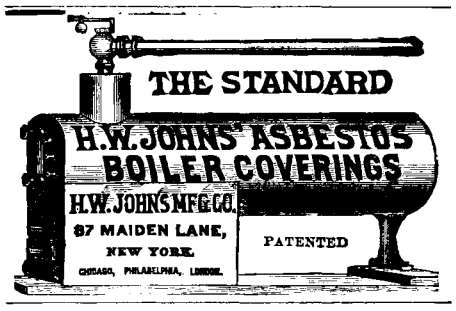

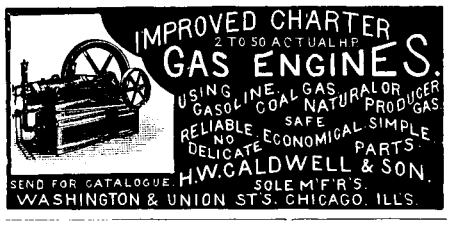
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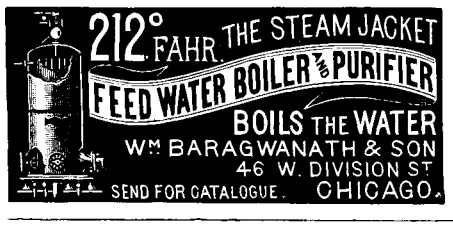
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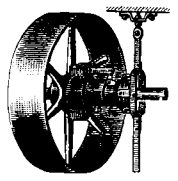

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